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HOW BEST TO EAT UNDER WAR CONDITIONS*

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BOSTON

NUTRITIONAL requirements in wartime do not differ from those of peacetime, except in so far as some persons may be more active in wartime and hence have somewhat increased requirements. Furthermore, the nutritional requirements for Bostonians do not differ from those for Londoners or other people, although they may be satisfied by entirely different foods. These statements seem simple and obvious, but many forget them under the emotional strain of war. It is of more national importance in time of war that nutritional requirements be obtained, than it is in peace because good nutrition is an essential factor for maintaining and improving the health of civilian and armed forces and their morale. With proper leadership, intelligent planning and common sense on the part of administrative officials and the public, there is no reason — barring unforeseen crop failure — why the people of our country and our armed forces cannot be well fed from a nutritive viewpoint, and why we cannot at the same time contribute measurably to the feeding of people in other countries. Undoubtedly our choice of foods will be restricted, as well as the quantities of them, but this need not interfere with nutritional well-being; in fact, the individual nutritional status of many persons may actually improve by intelligent application of well-established nutritional facts.

Essentially the question of how best to eat under war conditions involves a consideration of two problems: What are the nutritional requirements for health, and how may we obtain these from available foods? As part of the second problem, there should be some understanding of the effect of processing on the nutritional quality of the food.

Before considering the nutritional requirements for health, I shall mention briefly what food does for us and why we need it. We need food for body-building and repair; we need it for body heat and energy; and we need it for supplying ready-made, or enabling us to make, substances such as vitamins, enzymes and hormones for regulating body processes, including growth and reproduction, and for the normal functioning of organs, nerves and muscles. In addition to these food functions that are necessary for health, the eating of good food is one of the pleasures of life. Not many will deny the taste appeal, the satisfaction, the sheer enjoyment derived from eating an excellent dinner. Do not forget the pleasure value of food when some publicity-seeker proclaims that soon our daily nourishment may come from a few small capsules or pills.

The nutritional requirements for good health, whether in war or peace, consist of adequate amounts of protein, fat, carbohydrate, certain minerals, certain vitamins and water.

It may be well at this time to emphasize a point that is frequently overlooked by many nutritionists, namely, that there are no absolute requirements known for any of these food factors. All the requirements spoken of are relative ones. The amount of protein needed depends on the amount of fat and carbohydrate in the diet; the amount of fat needed depends on the amount of carbohydrate and protein in the diet; the amount of calcium needed depends on the amount of other basic minerals in the diet; and the amount of thiamine needed depends on the amount of carbohydrate and fat in the diet. Hence, tables of nutritional requirements usually refer to an average person on an average diet. The figures given are optimal, as they should be for optimum health — sufficiently high to allow a generous margin of safety for individual differences in requirements, and to cover any errors in the present-day knowledge of nutrition. Thus, if the adult requirement for protein is given as 70 gm. per day, this should not be

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understood to imply that if one gets 50 gm. a day he will be malnourished. That depends on the rest of the diet and on one's personal physical status. If the adult requirement for vitamin A is given at 5000 units per day, this does not imply that if one receives 3000 units per day he will be malnourished. This amount may or may not be sufficient, but in any case he is skating on thinner ice. There is less margin of safety so far as the vitamin A requirements are concerned, and unless the person concerned gets enjoyment merely from being contrary, or has good evidence that 5000 units of vitamin A is too high a value for the average adult, better health would probably be enjoyed by receiving the amount suggested by a majority of the best nutritionists of today.

Protein is the principal nitrogenous constituent of animal and vegetable tissue. It is the basic constituent of protoplasm. Protein may also, in the body, be converted into carbohydrate and be used as a source of energy. Chemically, the proteins are large, complex molecules. In the process of digestion these large molecules are broken down into units that are simpler from a chemical viewpoint, and ultimately into what are called amino acids. There are approximately twenty-four known amino acids, and of these about half are termed essential. This means that the body tissues cannot make them and that they must be obtained ready-made from food. The biologic or nutritional value of proteins is considered in terms of their content of essential amino acids. Thus, casein, the principal protein of milk, is a complete protein; it is of high biologic value because it contains all the amino acids known to be essential to life. Zein, the protein of corn, is an incomplete protein; it is of lower biologic value because it lacks two of the essential amino acids. Generally speaking, proteins of animal origin, which include not only meat but milk, eggs, fowl and fish, are of higher biologic value than are vegetable proteins. But vegetable protein is perfectly adequate in so far as it supplies many of the essential amino acids, and it supplies other amino acids (as does animal protein) that, although not essential for life, certainly contribute to body economy. In peacetime most people obtain the main part of their protein from animal meat, particularly the so-called "muscle meats" of steers, pigs and sheep, and a smaller amount from meats such as liver, heart, kidney, tongue, fish and poultry, from milk and cheese or from vegetable protein. The answer to the question how and where protein requirements should be obtained in wartime, when muscle meats may be scarce or unobtainable, is obvious. Vegetarians are certainly not upset about meat rationing, and George Bernard Shaw is an excellent example of long-lasting, vigorous health. They obtain protein not only from vegetables but from milk, cheese, eggs and fish. For the average adult, 1 gm. per kilogram of body weight — which for the average adult means 70 gm. — is a sufficient amount. It should be noted that this 70 gm. is of protein, not of meat. Only about 25 per cent of meat is protein, the other 75 per cent being water.

Fats are the most potent source of energy. When completely utilized they furnish twice the energy value per unit amount that carbohydrates or proteins do. A most important function is that they serve as carriers for the fat-soluble vitamins, which from the viewpoint of the practical nutrition of normal adults means only vitamin A. Experimentally, certain unsaturated fatty acids have been found to be essential for the rat. It is not known whether man needs these unsaturated fatty acids and whether he must obtain them from food, but it is most unlikely that these acids are important in practical adult human nutrition.

When it is said that vitamin A is the only fat-soluble vitamin of importance in practical human nutrition, this does not mean that the other vitamins are not needed, but only that they are not of importance in planning normal adult diets. This may be for a reason such as a small requirement that is easily obtained from almost any foods, or the synthesis of certain nutrients, such as vitamin K, by intestinal bacteria.

Fat is obtained in the human diet from both animal and vegetable sources. Butter and lard are the principal animal fats consumed; the vegetable oils most commonly used are those derived from corn, soybeans, olives, peanuts and cocoanuts. Hydrogenated cottonseed oil is the basis of such products as Crisco. Margarines, such as oleomargarine, are made from animal or vegetable fats. When vitamin A is added to the margarine, it is fully as nutritious for adults as is butter.

How much fat is needed in the diet? This too depends on one's physical status and on what else is eaten. Generally the fat in the diet is more than the protein and less than the carbohydrate, ranging in amount from 100 to 150 gm. But one can get along reasonably well with less fat provided that sufficient carbohydrate is available to meet energy needs and that a source of the fat-soluble vitamin A is also available. This is conveniently possible, since the body can make vitamin A from carotene, the yellow pigment present in many green and yellow vegetables.

Carbohydrate is plentiful in the diet, in fact too much so for many people. Its main sources are

flour, sugar, rice and starchy vegetables, particularly potatoes. Fruits also contain variable amounts of sugar.

How much carbohydrate is needed in the diet? One really needs none so far as nutrition is concerned — there is nothing "essential" about carbohydrate, but it is the cheapest source of energy available. Also large amounts of it can be stored in the body in the form of glycogen, and also as fat, since the body can form fat from carbohydrate. Because of the ease with which carbohydrate may be obtained, and its low cost, large amounts are used in the diet. A sedentary person consumes 200 to 250 gm. per day, whereas a person doing hard physical labor may consume three to five times that amount.

Certain inorganic or mineral elements are just as necessary to health as are protein, certain vitamins or water. Twelve minerals are known to be necessary in good nutrition; these are calcium, iron, phosphorus, copper, sodium, potassium, magnesium, manganese, iodine, chlorine, sulfur and zinc. Many of these are necessary only in minute amounts. Sodium and chlorine are needed in relatively large amounts, but are easily supplied by the use of table salt. In the inorganic elements the diet is most likely to be deficient in calcium and iron, and among those who live in the inland areas between the Alleghenies and the Rockies, an iodine lack is possible. In such locations the use of iodized salt in cooking and for the table is recommended. Iron is obtained from meat, particularly liver. It is also contained in eggs, leafy green vegetables, potatoes, dried fruits and whole-grain cereals. Milk and cheese are the only really good food sources of calcium, although small amounts are drawn from most vegetables and from meats. The diet will certainly be low in calcium unless enough milk in some form is present.

It is sufficient to say that mineral requirements are well met through the use of iodized table salt, ample portions of the foods listed as good sources of iron and some form of milk for calcium.

Of the fat-soluble vitamins, A, D, E and K, only vitamin A is of practical importance in the nutrition of the normal adult. The best sources of vitamin A are liver, egg yolk, whole milk, cream and butter, but many persons do not eat liver frequently, or do not drink much milk or eat many eggs, and with butter difficult to obtain where will one get vitamin A? Fortunately dark-green leafy vegetables and yellow vegetables contain a substance called carotene, which in the body is converted into vitamin A. Another safety factor is the capacity of storing large amounts of vitamin A, particularly in the liver and kidneys. Thus, if in the summertime green leafy and yellow vegetables and summer butter are consumed in large amounts, sufficient vitamin A is stored to help one through the winter.

Of the water-soluble vitamins, ascorbic acid and several of those of the vitamin B complex are required. It is important to know that one does not have the ability to store the water-soluble vitamins for any length of time, as is the case with the fat-soluble vitamins. Thus they must be provided for regularly in the diet.

Ascorbic acid is obtained chiefly from citrus fruits — oranges, grapefruit, lemons and tangerines — and from tomatoes or raw cabbages. Small but significant amounts are derived from potatoes if they are cooked in the jacket. This is necessary because ascorbic acid is easily destroyed by contact with the air, particularly at an elevated temperature. From the practical viewpoint a diet will be deficient in vitamin C if citrus fruits, tomatoes or raw cabbages are not included in it. Half a grapefruit or half a glass of orange juice — that is, about 4 ounces — will furnish approximately two thirds of the daily requirement; about twice as much tomato juice is required. Pineapple juice is a poor source of vitamin C.

The various members of the vitamin B complex are obtained chiefly from meats, which include fowl and fish, particularly liver and kidney, from milk and cheese, from legumes, such as peas, beans and peanuts, and from whole-grain cereal or bread. The members that are known to be necessary in human nutrition and that must be considered in the selection of food are thiamine, riboflavin and niacin. There is little doubt that other members are required in human nutrition, but their importance in food planning is yet to be determined. From the viewpoint of practical nutrition, the sources of thiamine, riboflavin and niacin are also the sources of the other members of the vitamin B complex. Milk and liver are the best sources of riboflavin, and without either the diet may be low in this substance.

Water need only be mentioned. It serves as a solvent and is vitally concerned with all phases of health. Actually, as is well known, one can live longer without food than without water.

I shall now discuss somewhat more practically how one can obtain an adequate protein supply from a variety of food. This is important for a number of reasons; protein is vital for health, whereas, strictly speaking, fat and carbohydrate are not; further restrictions are apt to involve the protein foods; and the protein foods are good carriers of many of the minerals and vitamins.

At present the weekly adult meat ration approximates 1¾ pounds, or 840 gm. The amount of bone varies with different cuts, but assuming an

average proportion of 20 per cent, this gives 672 gm. of meat per week. As already stated, only about one fourth of meat is actually protein, the other three fourths being mostly water. Thus, the ration yields 168 gm. of protein per week, or about 24 gm. per day. This amount is obtained from about 100 gm. of meat, and for comparison it might be mentioned that one average-sized pork chop has approximately this weight. It is therefore seen that with the present meat ration one should be able to obtain about one third the desired amount of protein. What additions can be made from available foods so as to raise the protein intake to at least 70 gm.?

Table 1 shows that it is a fairly simple matter to obtain the desired 70 gm. of protein per day, or to exceed this level. It should be emphasized that fish, sea food and poultry are approximately equal to the rationed meats in nutritive value. It is also important to note the richness in protein of beans, particularly the soybean. In addition, cheese, peas, lentils, peanut butter and the cooked cereals are good sources of protein. It should be clear how a diet adequate in protein can readily be planned from available foods. In fact, if unrationed meats were added to the rationed list and the daily allowance cut in half, one could still have a diet nutritionally adequate in protein provided there was a plentiful supply of the vegetable proteins and of milk.

TABLE 1. *Means of Obtaining the Desired Daily Amount of Protein (70 gm.) and a List of Foods Containing Appreciable Amounts of Protein.*

Source of Daily Protein Requirements		Foods Rich in Protein
Food	Protein	
	gm.	
Rationed (or unrationed) meat	24	Rationed meat (80 gm. per serving)
Milk (1 glassful)	8	Unrationed meat — fish, sea food and poultry (80 gm. per serving)
Egg (1)	7	Beans (6 to 11 gm. per serving)
Bread (4 slices)	10	Lentils (9 gm. per serving)
Vegetables (2 servings)	8	Cheese (6 to 10 gm. per serving)
Legumes (1 serving)	7	Peas (6 gm. per serving)
Potato (1)	2	Peanut butter (5 gm. per tablespoonful)
Miscellaneous foods (fruit, salad, dessert, cereal etc.)	4	Cooked whole-grain cereals (4.5 gm. per serving)
	—	Ice cream (4 gm. per serving)
Total	70	Bread (2.5 gm. per slice)

As has been mentioned, it is important to stress the protein foods, because they are vital to health and because they generally serve as a good supply of minerals and of the vitamin B complex. They do not, however, assure an adequate supply of ascorbic acid or of vitamin A. Ascorbic acid will be adequately supplied in ordinary diets only when some citrus fruit or juice, tomatoes or tomato juice, or raw cabbage is consumed daily. For vitamin A one must depend to a considerable extent on dark-green leafy and yellow vegetables. Butter, or oleomargarine enriched with vitamin A, in the amounts ordinarily used does not contribute more than about one tenth of the daily requirement of vitamin A. In an average diet, dark-green leafy and yellow vegetables supply about half the vitamin A requirement, and butter, milk, eggs and tomatoes furnish the other half. Dried apricots are an excellent source of vitamin A, but they are now unobtainable, since the armed forces take most of the supply. It should be emphasized that lettuce is not a dark-green leafy vegetable. In the amounts usually consumed, it contributes small amounts of minerals and of certain vitamins, but its nutritional quality is highly overrated. Green-leaf lettuce obtainable in the spring and summer is far superior in nutritional quality to the bleached lettuce of wintertime, but it is inferior to such dark-green leafy vegetables as broccoli, spinach, turnip greens, kale, beet greens, Swiss chard, collards, dandelion greens, endive, escarole, mustard greens and watercress. Green peppers are also a good source of carotene — that is, of provitamin A.

Although the nutritional quality of food depends to a considerable extent on the type of soil on which the food is grown, and on weather conditions, it is principally influenced by the following factors: the length of time from harvesting the food until it is processed; the length of time and the temperature of any blanching treatment or any process in which the food is in contact with water; contact with bright sunlight or unusual exposure to air, as would be obtained if the food were chopped or finely divided; the reaction of the food — that is, whether it is slightly acid or alkaline; and the degree and duration of heat used in processing the food.

Minimum values for the above, consistent with adequate preparation of the food, and an acid reaction are desired to preserve the maximum nutritional quality. The nutrients that are most likely to be lost in processing are ascorbic acid, thiamine, riboflavin and vitamin A. Accordingly, in home cooking, excesses of heat and of water should be avoided, and water that is added in cooking should be used over again for soups or gravies. Baking soda should not be added to the cooking water, and there should be a minimum amount of stirring. The pressure-cooker or steam type of cooking utensil is best from the viewpoint of maintaining nutritional quality.

Most commercially canned food is of a high nutritional quality, approaching that of the freshly harvested product, and is frequently superior to that of raw food obtained at many markets and that of home-canned food. The reason for this is that the food is harvested primarily for canning, is brought directly to the factory and is completely

processed within three or four hours, whereas the food that goes to market may not be bought until the next day or next week. Commercially canned food usually receives a short blanching with boiling water or steam, and is then cooked in a sealed container, which minimizes contact with the air. The cooking is usually at a high temperature and for a relatively short period. It should be emphasized that the brine or liquor of canned vegetables contains a considerable portion of the water-soluble nutrients. It should not be discarded, but should be used as a sauce with the vegetable or in the preparation of gravies.

Frozen food likewise has a high nutritional quality. Here, too, the food is harvested primarily for freezing, and is processed a short time after picking. It is important to know that in the freezing process the cells are usually ruptured, and that when the food is warmed there is a rapid loss of oxidizable and water-soluble nutrients. Hence it is advisable that frozen food be cooked and consumed promptly after being thawed.

One reads much these days about dehydrated food, and there is no doubt that a good-sized dehydrating industry has developed to meet the wartime demand for dehydrated food, which obviously offers an enormous saving in transportation. But the dehydration of food on a commercial scale is a new and growing industry. There are numerous technics for dehydrating food, and changes are constantly being made to improve the process. Thus, to discuss accurately the nutritional quality of dehydrated food will be impossible until the technical process of dehydrating has been sufficiently stabilized so that analyses for nutritional quality today will apply to foods purchased next month. Important problems other than the actual dehydration of food are vitally concerned with dehydrated food; some of these are loss of nutrients during storage, protection from insects, packaging, rehydration and palatability of the end product. There has actually been insufficient experimental work on the nutritional quality of dehydrated foods to warrant any authoritative statement applicable to dehydrated food in general. Years of research by manufacturers of canned food have brought about improvements in food processing to the point where the nutritional value of commercially canned food is often equal to that of the fresh product from which it is made. There is every reason to believe that similar research efforts applied to dehydration will produce equally good results.

It might be appropriate to mention that the nutritive quality of food served in many restaurants is distinctly inferior to that of home-cooked food because it is frequently prepared several hours in advance and is kept warm, or is warmed over. This involves considerable contact with heat and air— hence, the inferior nutritional quality of the food. Losses in vitamin C are high, and losses in thiamine and riboflavin are probably considerable.

Much has been heard in the last few years about the superior nutritional quality of whole-wheat and enriched flour as compared with plain white flour. In the process of milling wheat to prepare flour the outer husk and the germ of the wheat kernel are removed. This results in considerable loss of nutrient value, specifically of the vitamin B complex, of minerals, particularly iron, and of some protein. Whole-wheat flour and, generally speaking, other dark flours retain more of these nutrients than does white flour, which results from a thorough milling. Because white flour and breads made from it are of poor nutritional value, and because a large portion of the American public prefers white bread, attempts were made to improve the flour. These procedures have been of two kinds: first, the addition of synthetic preparations of certain members of the vitamin B complex and of iron, and second, technical improvements in milling procedures so as to prepare a light-colored flour but one that still retains more of the nutrients than is done in the usual milling process. Bread made from enriched flour is termed "enriched bread." It is definitely superior in nutritional quality to white breads made from unenriched flour, but still does not measure up to whole-wheat bread.

It is of interest that Order No. 1 signed by the Secretary of Agriculture in his capacity as Food Administrator included a statement that beginning January 18, 1943, all white bread must be enriched to approved nutritive standards. This is a most important and desirable order, and will do much to improve the nutritional quality of the diet of many people. It is to be hoped that improvement in milling procedures will be vigorously pursued so that flours of light color and good keeping quality and yet of superior nutritional standards will be available.

Table 2 gives a basic outline for a daily diet of high nutritional value. A great variety of diets may be had within the framework of this outline, and from available foods. If one cannot get rationed meat, unrationed meat may be used; if one does not like milk, or cannot get it, cheese, if available, should be substituted, or vegetables of high protein value particularly beans, lentils and peas.

The frequent statement that all that is necessary to have good nutrition is to eat natural foods is not sound, because it is not complete; it does not

go far enough. It should be supplemented by adding, "a *proper combination* of natural foods." And one must know what combination of foods will provide a nutritionally sound diet. More emphasis is frequently placed on the use of natural foods than on their proper combination. Different natural foods differ greatly in their nutrient content, and it is easy to have a diet of natural foods and yet have an inadequate diet. For example,

TABLE 2. *Outline of Daily Diet for an Adult.*

Food	Quantity Required
Milk	2 glassfuls or 1 glassful and 1 serving of cheese
Meat	1 or 2 servings — rationed or unrationed (fish, fowl or sea food)
Eggs	3 or 4 per week
Vegetables:	
Potato	1 or 2 servings
Dark-green leafy or yellow	1 or 2 servings
Legumes	1 or 2 servings
Fruits	2 servings, 1 being citrus (or tomato)
Cereals	4 slices of whole-grain or enriched bread, or less bread and a serving of whole-grain or enriched cereal
Fats and sweets	To meet energy requirements, after the above foods have been consumed
Iodized salt	To season food

beets contain a small amount of thiamine and pork a hundred times more, yet they are both natural foods. Milk contains a small amount of niacin and peanuts two hundred times more, yet both are natural foods. It should be evident that a proper combination of foods is necessary for good practical nutrition, and in wartime, when certain foods are restricted, one should know what combination of available foods will provide a diet of high nutritive quality.

In conclusion, it may be appropriate to answer a few questions concerning butter and milk that many people are asking. Is oleomargarine of equal nutritive value to that of butter? For practical human nutrition oleomargarine enriched with vitamin A is fully equal to butter in nutritional quality. There are many eminent nutritionists who would not make such a statement, but I know of no experimental evidence applicable to human nutrition that contradicts it. In fact, oleomargarine with a standardized amount of vitamin A added to it may be superior to winter butter in vitamin A value because the vitamin A content of butter varies with the content of this vitamin in milk, and winter milk usually has a lower level than does summer milk.

Another question often asked is, Must an adult drink a pint of milk each day to have good nutrition? It is not necessary for anyone to drink milk, but the plentiful addition of milk to any diet is one of the best ways to improve its nutritional quality. Many people think of milk merely in terms of supplying calcium. This is wrong. Milk supplies a good amount of protein, which is of the highest nutritive value. It is also the best-known source of riboflavin; in fact, without milk in the diet, either as a beverage or ice cream or in cooked food, it is most difficult to obtain the desired amount of riboflavin. Furthermore, milk is a fair source of thiamine, and whole milk contains considerable vitamin A. Hence, in addition to being the best food source of calcium it is an excellent source of many other necessary nutrients, particularly some of those in which the usual American diet is low. Persons who do not drink milk or eat good amounts of cheese would definitely improve their diet by consuming a pint of milk per day.

A question that might be asked is, If milk is rationed, what then? Milk, whatever amount is available, should go first to infants, pregnant and nursing women, children and adolescents, and then to other adults.

* * *

In summary, nutritional requirements in wartime do not differ from those of peacetime, but it is of national importance in time of war that a determined effort be made to see that all our people and our allies are well nourished. Good nutrition is an important factor in maintaining and improving the health of the civilian and armed forces and their morale. Secondly, to have good nutrition, it is necessary to understand to some extent the nutritional requirements desired for good health, and particularly, from the practical viewpoint, to understand what combinations of available food each day are necessary to supply these requirements, and how to prepare this food with minimum loss of the nutrients it contains.

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SPINA BIFIDA AND CRANIUM BIFIDUM*

IV. An Unusual Nasopharyngeal Encephalocele

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AT THE Children's Hospital 546 patients have been seen with meningoceles distributed throughout the central nervous system.[1] Of these cases, 84 may be classified as encephaloceles, that is, herniation through a defect in the cranium. Among the encephaloceles, 63 were occipital, 9 were parietal, 6 were frontal, and 5 protruded into the nose. The case reported here is the only one in which anterior herniation of the brain occurred through a defect in the cribriform plate and presented in the nasopharynx. Dandy[2] described a patient with protrusion of the cranial content into the orbit, and outlined a satisfactory operative procedure for such cases.

Anterior encephaloceles must be extremely rare. Mood[3] reported 40 cases collected from the literature, dividing them into basal and sincipital varieties, which occurred with about equal frequency. The sincipital types present as external tumors, whereas the basal varieties are intranasal, intrapharyngeal or intraorbital. This author pointed out that herniation through the skull is made possible because of clefts between the various bones that are present either normally or pathologically during early development.

More recently, McGillicuddy[4] reported the case of a thirteen-year-old boy with an encephalomeningocele filling the left nostril and antrum but not

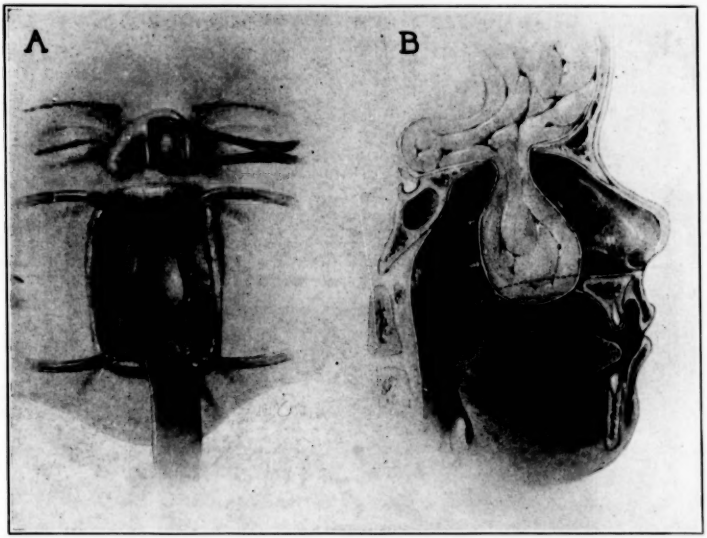

FIGURE 1.

A is a semidiagrammatic view of the encephalocele protruding into the left nostril and through the cleft palate. B is a midsagittal view showing the size and position of the encephalocele in relation to the cribriform plate and nasopharynx.

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FIGURE 2.

Sinus roentgenogram showing the absence of bony structures of the cribriform plate and of the ethmoid cells on the left.

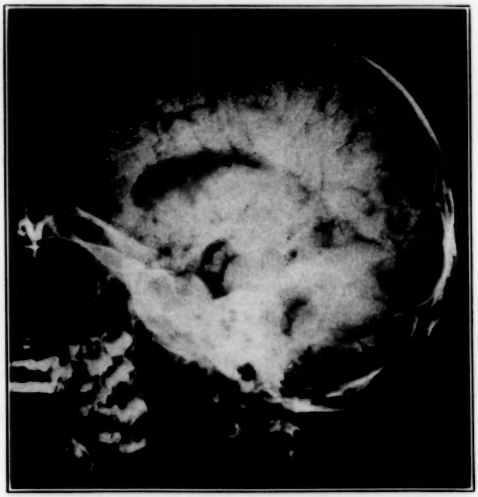

FIGURE 3.

Lateral pneumoencephalogram showing a normal ventricular system and subarachnoid spaces.

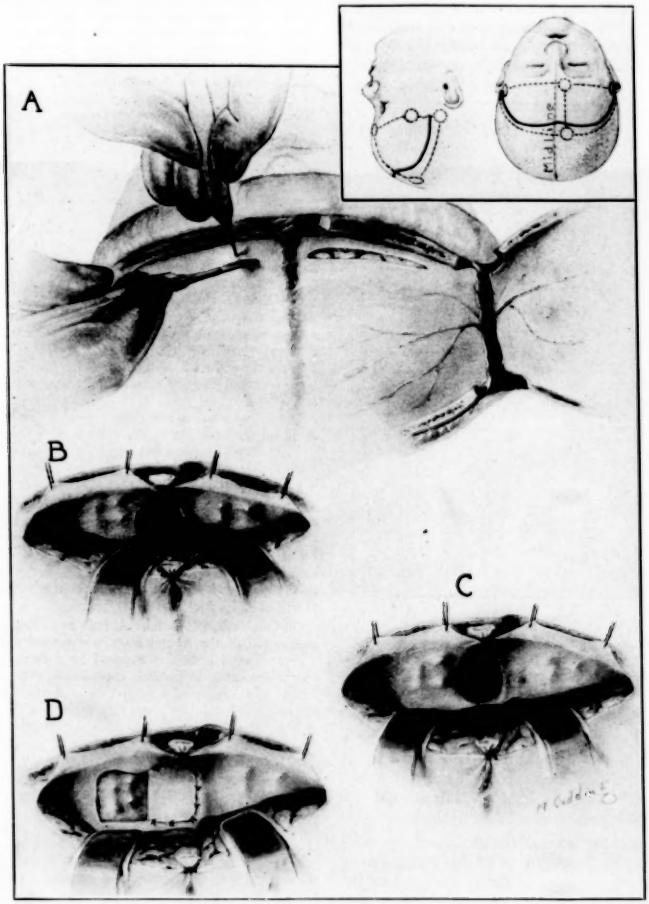

FIGURE 4.

In the insert, the solid line indicates the site of incision, and the dotted lines the limits of the right and left frontal bone flaps. In A, *the dura has been opened on either side of the longitudinal sinus at the anterior limit of the exposure. In* B, *the pedicle of the herniated brain at its origin from the left frontal pole has been exposed after division of the longitudinal sinus and falx and retraction of the frontal lobes.* C *shows the inside of the meningocele sac after amputation and removal of the herniated brain. In* D, *the dural flap has been reflected from the floor of the frontal fossa across the defect in the cribriform plate and has been sutured to the crista galli.*

visible in the nasopharynx. Partial removal had been done at three months of age, with no untoward sequelae. Intranasal removal with a tonsil snare was carried out and recovery was uneventful, but drainage from the nostril persisted.

FIGURE 5.
This shows the shrinkage of the meningocele sac in the nasopharynx, with resultant improvement of airway, as seen on the seventh postoperative day.

One year after operation the patient developed severe meningitis, which responded to chemotherapy, but he showed a slight recurrence in the upper anterior nares and continued to have rhinorrhea. McGillicuddy suggests that an intracranial approach to the pedicle was probably indicated.

The clinical problems of diagnosis and especially of neurosurgical management of this rare anomaly seem to make a report of the following case desirable.

R. A. N. (C. H. 242961) was first seen on June 7, 1940, at the age of 23 days. He was referred to the Children's Hospital because of a right incomplete harelip, cleft palate and a redundant skin tab over the tip of the coccyx. No family history of congenital anomalies could be elicited. He was delivered normally at full term and there were no postnatal disturbances. Examination revealed the above findings, and was otherwise negative except for a midline dimple in the skin of the sacral region. Plastic repair of the harelip was carried out uneventfully and the patient was discharged home.

He re-entered the hospital for repair of the cleft palate on September 28, 1942, the operation having been twice postponed in the interval because of mild upper-respiratory infection associated with nasal discharge. The interval history was otherwise negative and the patient's development appeared to be normal. Physical examination revealed a healthy child whose head was of normal size and shape; the fontanelles were closed. The nose showed flattening of the right external nares. The left nostril was almost completely blocked by a smooth, bluish-gray, fluctuant, soft-tissue mass medial to the inferior turbinate and extending posteriorly. A probe could be passed around the mass on all sides, so that it seemed to be attached superiorly. The mass did not shrink after the topical application of adrenalin.

There was a well-healed scar of the harelip repair with a good cosmetic result. A wide cleft of the palate extended from the uvula to within 1 cm. of the alveolar ridge anteriorly. A moderate growth of adenoid tissue was visible on the posterior pharyngeal wall. On either side of the nasal septum, smooth, bluish-gray, fluctuant masses were seen protruding over the margins of the cleft palate, that on the left measuring 1 by 1.5 cm. and that on the right 0.5 by 1.0 cm. (Fig. 1). These masses were observed to vary somewhat in size at different examinations.

Laboratory studies revealed normal urine and blood. A blood Hinton test and an intracutaneous tuberculin (1:1000 dilution) test were negative. Spinal-fluid studies were within normal limits.

Roentgenograms of the skull and sinuses showed absence of the normal bone structures in the region of the cribriform plate, with obliteration of most of the ethmoid cells (Fig. 2). A pneumoencephalogram showed the ventricular system to be quite normal in size, with no evidence of an unusual collection of air near the cribriform plate and no shift or defect in the lateral or third ventricles (Fig. 3).

On October 9, 1942, under Avertin and ether anesthesia, exploration of the frontal fossa was carried out through a right frontal bone flap exposed by a coronal incision. Extradural and intradural exploration over the right frontal lobe visualized a projection of dura-covered brain through a defect in the cribriform plate, and the diagnosis of anterior encephalocele was thus confirmed. However, this exposure was obviously inadequate for surgical removal of the lesion, so that routine closure was carried out.

The postoperative course was uneventful and on the 6th postoperative day, again under Avertin and ether anesthesia, the coronal incision was reopened. The right frontal bone flap was again elevated on a lateral hinge of periosteum. Two more burr holes were placed in the left frontotemporal region and a left frontal bone flap extending across the midline was elevated on a left periosteal hinge (Fig. 4).

The dura was then opened on either side of the sagittal sinus as far anteriorly as possible (Fig. 4*A*) and the sinus was ligated and divided. As the falx was divided down to the crista galli, an unusual number of large tributory veins leading into the anterior end of the sagittal sinus were divided between silver clips. Both frontal poles were retracted posteriorly, and it became easy to visualize a herniation of brain extending from the left frontal lobe downward and forward through a defect in the cribriform plate, which displaced a rudimentary crista galli toward the right (Fig. 4*B*). The herniated brain could not be delivered from its extracranial compartment,

so that it was amputated from the frontal pole and subsequently removed piecemeal from the meningeal sac (Fig. 4*C*). This sac, which could then be invaginated into the frontal fossa, was, however, left intact in the position in which it was found in order to avoid communication of the meninges with the nasal cavity. The inner surface of the meningocele sac was superficially coagulated with endothermy current in the hope of speeding its obliteration.

A flap of dura and periosteum was next raised from the floor of the frontal fossa laterally, turned on a hinge, and sutured across the defect to the crista galli (Fig. 4*D*). Routine closure of the dura, bone flaps and scalp was carried out.

The postoperative course was again uneventful. On the 7th postoperative day, examination under Avertin anesthesia revealed the masses in the nasopharynx to have shriveled markedly (Fig. 5). The mass in the left nostril was smaller but not necrotic. The nasopharyngeal airway was much improved. On the 14th postoperative day, the patient was discharged to the Wellesley Convalescent Home for 4 weeks, at the end of which time repair of the cleft palate was planned.

In this case, several associated developmental defects in the facial area were present. A cleft palate resulted from failure of the lateral palatine processes to unite properly. Failure of the right maxillary process to fuse with the median nasal process resulted in a right incomplete harelip. According to Arey,[5] the embryonic ethmoidal cartilage consists of a mesial mass and of paired masses lateral to the olfactory sacs. The lateral masses ossify first into the spongy bone of the ethmoidal labyrinths. Fibers of each olfactory nerve pass between the unjoined mesial mass and the adjacent lateral mass. Later, cartilaginous trabeculae surround these bundles of nerve fibers and interconnect the three masses. When these perforated parts of the completed ethmoid become ossified, they are designated the cribriform plates. Presumably, failure of these cartilaginous trabeculae to form or to ossify resulted, in this case, in a defect in the cribriform plate that permitted herniation of the brain into the nose and nasopharynx.

FIGURE 6.
These photographs of the patient were taken two months postoperatively.

This case proved interesting not only because of the rarity of the lesion but because the even more uncommon association of the cleft palate provided an excellent view of what might otherwise have been a hidden anomaly. The possibility and danger of mistaking such a lesion for a polyp or tumor of extracranial origin and of attacking it surgically through the nose or mouth are self-evident. The development of a spinal-fluid leak into a contaminated field followed by meningitis would be an almost certain complication.

The case is also interesting because the patient was an otherwise apparently normal boy (Fig. 6) with a series of congenital anomalies, all suitable

for satisfactory surgical therapy. The importance of delaying the repair of the cleft palate until an adequate airway had been established by removal of the encephalocele should be emphasized.

The surgical approach outlined and illustrated in this report proved highly satisfactory, and is recommended for attacking lesions of this kind in the region of the cribriform plate.

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HEMORRHAGE AND PURPURA CAUSED BY DICOUMARIN*

Report of a Case

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FIRST isolated and then synthesized by Link and his associates,[1] dicoumarin is the active principle in spoiled sweet-clover hay causing hemorrhagic disease in cattle. A threefold purpose motivated its introduction as a possible useful therapeutic agent: the prevention of thrombosis, especially postoperatively, the alleviation of thrombosis that had already been established[2] and the treatment of peripheral vascular diseases.[3]

The patient described herein received prolonged treatment with dicoumarin and developed severe and alarming but transient hemorrhagic and purpuric symptoms. Since this patient was observed, another case has been reported in which similar symptoms appeared after prolonged treatment with dicoumarin from this same batch.[4]

Case Report

A 50-year-old housewife weighing 137 pounds was admitted to the Knickerbocker Hospital on September 28, 1942, complaining of weakness and progressively increasing painless hematuria of 1 month's duration. There was no history of any other bleeding, purpura or jaundice. The previous history included a hysterectomy, repair of cystocele and rectocele and hemorrhoidectomy at another hospital on August 19, 1942, following which the patient lost 6 pounds. There was nothing else of importance in the family, social or previous medical history. Two days after admission purpuric patches appeared on both upper extremities and bleeding from the gums started.

Physical examination at that time revealed an anxious-appearing and pallid woman. The pulse was 112 and thready, and the rectal temperature was 100°F. Blood oozed from the gingival margins of the gums and dripped from the upper teeth. The patient expectorated numerous pea-sized blood clots. There was no epistaxis.

The purpuric manifestations, which appeared only on the upper extremities, were bilateral and occurred as bluish raised areas covering the entire dorsum and proximal phalanges of both hands, round patches 2.5 cm. in diameter over each styloid process and blue-black subcutaneous areas 5 cm. in diameter over the flexor and extensor surfaces of both elbows. There were no petechiae and no telangiectases. The heart was normal. The blood pressure was 125/90. The lungs were clear throughout. Neither the liver nor the spleen was palpable. Moderate tenderness was elicited over the region of the urinary bladder. There was no lymphadenopathy. The urine was frankly bloody with innumerable red cells per low-power field. A blood Wassermann reaction was negative.

Venous blood examined shortly after collection in Wintrobe's oxalate mixture revealed the following counts: red cells 2,620,000; hemoglobin (Sahli) 50 per cent (7.25 gm.); white cells 8300, with 4 per cent nonsegmented neutrophils, 64 per cent segmented neutrophils and 32 per cent lymphocytes. Platelets numbered 370,000 per cubic millimeter. The clotting time (Lee and White) was 16 minutes, and clot retraction appeared normal within a few hours. The bleeding time (Duke) was 13 minutes. A capillary-fragility test (blood-pressure cuff maintained midway between the systolic and the diastolic pressure for 5 minutes) yielded negative results, nor did slapping or pinching the flexor surface of the forearm produce petechiae. During the time the venous-blood return was impeded by this test, the distal purpuric areas increased in size. The prothrombin percentage obtained by comparing the prothrombin time (Quick) of a normal control with that of the patient was 19. The hematocrit was 26 cc. of cells per 100 cc. of blood. The blood plasma was not icteric.

Smears made from marrow aspirated from the sternum by the puncture method showed the following percentages of cells: myeloblasts, 0.1, myelocytes, 21.9, young forms, 28.0, nonsegmented neutrophils, 11.0, segmented neutrophils, 1.7, eosinophils, 4.6, lymphocytes, 15.0, plasma cells, 1.2, normoblasts, 16.5 (basophilic cells, 0.2, polychromatophilic cells, 11.6, orthochromic cells, 4.7).

The correlation of the clinical findings and the blood picture at this time was difficult. The bone-marrow changes were nonspecific. There was no platelet reduction, no capillary fragility and no abnormality in clot retraction. However, the bleeding time was prolonged, the coagulation time was increased, and a marked prothrombin deficiency was evident, associated with purpura and bleeding from the gums.

Although the patient's blood was Group A, cross-matching with two available Group A donors and one Group O donor was unsuccessful because of the appear-

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ance of macroscopic agglutination. Peculiarly, a few drops of the patient's blood spread over a glass slide dried (rather than clotted) into large macroscopic clumps.

The patient was promptly transfused with 250 cc. of citrated, banked blood plasma without any untoward reaction. Twelve hours following this transfusion bleeding from the gums ceased and no new purpuric patches appeared.

Further investigation of the history revealed that the patient had received dicoumarin in almost daily doses of 100 mg. During the 32 days immediately prior to hospitalization, a total of 2800 mg. had been administered. Exhibition of dicoumarin was instituted 2 weeks postoperatively, subsequent to the occurrence of fever and chills, which had been ascribed to embolization. Hematuria, which appeared after repeated catheterization, was first noted on the day dicoumarin was started, but prior to its administration, and persisted with increasing severity until 8 days after its withdrawal.

Two subsequent transfusions with 500 cc. of banked blood, Group O, were complicated by moderately severe febrile reactions (Table 1). A third transfusion with fresh Group A blood was followed by chills, fever and collapse after 100 cc. had been injected. This last reaction inaugurated a 3-day episode of borderline jaundice without the appearance of bile, hemoglobin or excess of urobilin in the urine. Regrouping and cross-matching established the compatibility of this transfusion. Reactions to other transfusions in the hospital at this time were nil.

The return of the blood findings to more normal levels and the patient's slow convalescence are indicated in detail in Table 1.

TABLE 1. *Summary of Data.*

Time	Red-Cell Count	Hemoglobin Content	White-Cell Count	Platelet Count	Bleeding Time	Coagulation Time	Clot Retraction	Capillary Fragility	Traumatic Capillary Sensitivity	Prothrombin Level	Clinical Data
	$\times 10^6$	%	$\times 10^3$	$\times 10^3$	*min.*	*min.*				%	
Before dicoumarin	4.0	85	8.9	–	–	–	–	–	–	–	
After dicoumarin											
1st day	3.6	66	10.0	–	–	–	–	–	–	–	Hematuria; purpura.
2nd day	2.6	50	8.3	370	13	16	Normal	Normal	Increased	–	Hematuria; increased purpura; bleeding from gums; plasma transfusion (250 cc.).
3rd day	–	–	–	–	–	–	–	Normal	Increased	19	Hematuria; purpura; no bleeding from gums.
4th day	1.7	30	14.0	170	20	10	Normal	Normal	Increased (?)	20	Hematuria; purpura; blood transfusion (500 cc. Group O); fever to 103.4°F.
5th day	1.6	30	9.0	90	8	10	Normal	Normal	Normal	–	Hematuria (slight); purpura; blood transfusion (500 cc. Group O); fever to 104.8°F.
7th day	2.4	42	6.2	220	1	10	Normal	Normal	Normal	24	No hematuria; purpura.
9th day	2.1	42	22.8	236	2	8	Normal	Normal	Normal	61	Purpura (slight); jaundice (mild); blood transfusion (500 cc. Group A); fever to 106°F.
11th day	2.3	45	17.4	–	–	–	–	–	–	80	No purpura; no jaundice.
19th day	3.0	60	9.0	–	–	–	–	–	–	–	Discharged

Discussion

The clinical findings and blood picture resulting from dicoumarin toxicity have been ascribed to the development of a severe hypoprothrombinemia.[2] In this case, bleeding from the gums and purpuric manifestations ceased when the prothrombin percentage reached 20. It is possible that 20 per cent represents a critical level below which phenomena appear. The findings suggest, however, the involvement of another factor, since the prothrombin percentage was only 24 when the bleeding time had fallen to one minute and the purpuric and hemorrhagic activity had been quiescent for four days. It is difficult to assume that the change in the prothrombin percentage from 20 to 24 was alone responsible for the drop in bleeding time from 20 minutes to 1 minute and the cessation of all symptoms. Possibly the phenomenon described below may be of assistance in elucidating the mechanism of the purpura and hemorrhage.

It is noteworthy that the lobe of the ear, the site chosen for the Duke test for bleeding time, became blue and swollen. This phenomenon is known to occur in thrombocytopenic purpura. But, unexpectedly, the increased capillary fragility and diminution of platelets usually associated with thrombocytopenic purpura were not present.

With the same procedure as that employed in the Duke bleeding-time test, the forearm was punctured to a depth of 1 cm. by a 26-gauge needle. The site chosen was an area free from visible blood vessels 7 cm. below the bend of the elbow. Within a few minutes the area surrounding the needle-puncture wound became black and blue. After the initial bleeding had ceased, a tourniquet was applied proximally and the purpuric areola perceptibly increased in size. At the

same time the other purpuric areas distal to the tourniquet became larger.

On removing the tourniquet, a 2 cm.-wide encircling band of purpura was found. Its origin was obviously traumatic and resulted from the application of the tourniquet. The blood vessels must therefore have been pathologically sensitive to trauma, since it is not usual for the application of a tourniquet to produce purpura. This pathologic sensitivity of the blood vessels to trauma is probably distinct from capillary fragility.

It is possible that the purpuric areas appearing over the bony prominences of the hands, wrists and elbows and the hemorrhage from the gums were traumatic in origin and were indeed manifestations of this underlying sensitivity of the blood vessels to trauma. The positive needle-puncture tourniquet test described herein probably represents an abnormal sensitivity of the vascular bed to trauma. This test is not influenced by the presence of adequate numbers of platelets or of an increased capillary fragility. Whether the hypoprothrombinemia alone or another principle in the dicoumarin is the cause of this vascular sensitivity to trauma is not known.

The needle-puncture tourniquet test for traumatic vascular sensitivity was tried on several patients, with interesting results. In a case of hypertension with pyelitis, there was a negative traumatic vascular-fragility test as judged by the nonappearance of a purpuric areola, but a positive capillary-fragility test with the appearance of many petechiae. The bleeding time in this patient was 1½ minutes. A patient with terminal subleukemic myelosis and many purpuric patches over the abdomen had a positive needle-puncture tourniquet test but the capillary-fragility test was negative. The bleeding time was 2 minutes. A third patient developed a small hematoma from the puncture of an underlying blood vessel. The needle-puncture tourniquet test was negative on the other arm. In none of the other cases was either of these tests positive. No control developed areolas around the needle-puncture wound, despite the proximal application of a blood-pressure cuff at a level midway between the systolic and the diastolic pressure for five minutes.

Summary

A patient is described who received 2800 mg. of dicoumarin in thirty-two days and developed hemorrhagic and purpuric manifestations with a prolonged bleeding time and a marked prothrombin deficiency without platelet reduction, capillary fragility or abnormality in clot retraction.

It is suggested that dicoumarin toxicity induces not only a hypoprothrombinemia but also an increased sensitivity of the vascular bed to trauma.

A needle-puncture tourniquet test to elicit sensitivity of the vascular bed to trauma is described.

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MEDICAL PROGRESS

EPIDEMIOLOGIC ASPECTS OF FOOD-BORNE DISEASE (Concluded)

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FOOD POISONING

Botulism

BOTULISM is due to the production of a heat-labile toxin formed by the germinating spores of *Clostridium botulinum* in underprocessed canned foods. Two varieties, Types A and B, are usually encountered in the United States; recently, cases due to Type E were reported in California. To quote Dack[2]:

> War conditions in 1917–18 served as a stimulus to preserve more food, and at that time the danger of botulism was not recognized. Hence, considerable spoilage from underprocessing was encountered, with an occasional outbreak of botulism. Research to determine the cause of spoilage showed that the cold-pack method of processing foods for home canning, as recommended by the government at that time, was entirely inadequate to prevent botulism.

During the ten years from 1931 to 1940, inclusive, there have been an average of 11 outbreaks each year. From 1899 to 1941, according to Meyer,[149] there were 359 outbreaks, of which 4 were in Massachusetts, 1 in Connecticut, 1 in Maine and the remainder outside the New England states. Geiger, Dickson and Meyer[150] found that up to 1922, 62 per cent of the outbreaks in California were due to home-canned apricots, pears, string beans, asparagus and corn and commercially packed ripe olives and spinach. Only 24 per cent were due to animal products, which are the usual source of botulism in Europe. Dack[2] analyzed the foods responsible for 359 outbreaks between 1899 and 1941. The foods most frequently involved were string beans (80 outbreaks; 3 with commercial canning), corn (36; 1 with commercial canning), spinach or chard (21; 10 with commercial canning), beets (16; 2 with commercial canning), asparagus (13; none with commercial canning), olives (13; 12 with commercial canning), beans (10; none with commercial canning). The amount of acidity in the food is an important factor in determining the limits of growth of *Cl. botulinum*. Growth is uncertain at pH 5.4 or lower. The food may or may not give evidence of spoilage, such as a foul odor or a sharp taste.

Hunter, Weiss and Olson[151] observe that prior to 1935 botulism was unknown in South Dakota and *Cl. botulinum* could not be isolated from the soil. In that year, however, the disease made its appearance as an epidemic of limber-neck among chickens fed on home-canned corn that showed signs of spoilage. The following year, a family outbreak occurred. String beans that had been home-canned by the cold-pack method were slightly foamy and faintly rancid. They were rinsed in cold water and served to 5 persons. Four ate them and died within forty-two hours; 1 did not and kept well. Many chickens ranging in the back yard died of limber-neck, presumably after drinking from a puddle into which the kitchen sink drained. Type A *Cl. botulinum* was isolated from the beans. These authors conclude that canning by the cold-pack method should be discontinued if further outbreaks of botulism are to be avoided.

Twenty cases in Tennessee prior to 1939 are reviewed by Tucker and Swanson,[152] who report 2 cases caused by eating home-canned okra and possibly home-canned beans. Type B *Cl. botulinum* was isolated from the okra, and Type B toxin was found to be present in both the beans and the okra.

In Oregon, Watson[153] treated 16 cases of botulism, with a case fatality rate of 30 per cent. He states that large doses of bivalent (Types A and B) antitoxin are imperative in the treatment of the disease. Prompt intravenous administration, followed by repeated intramuscular injections, was described as the most satisfactory procedure. Oxygen administration is recommended by this author, who used the respirator when respiratory paralysis seemed imminent. Most writers, however, consider the specific treatment of the disease unsatisfactory. The mortality rate is usually 60 to 70 per cent.

Geiger[154] reports a family outbreak of botulism in California involving 3 cases, with 1 death. The family of 6 ate for supper macaroni prepared

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with commercially canned mushroom sauce designated as "Italian style," milk, apples and oranges. The sauce was not heated but was poured directly over the cooked macaroni before serving. The three children who were affected obtained the first servings. Three other members of the family ate the same meal, but did not become sick. The incubation periods in the 3 sick children were ten, seventeen and 20 hours respectively. The can was not a "swell" (a can bulged by fermentation) and the sauce was normal in appearance and taste. It had been manufactured in California from mushrooms that had been dried in Yugoslavia and shipped in sealed cans. In manufacture, the cans (No. 1 size) had been heated at 245°F. for forty-five minutes. The pH of other cans varied from 4.2 to 4.9. Type E *Cl. botulinum* was obtained from the sides of the empty tin.

The New York State Department of Public Health[155] calls to the attention of health officers the possibility of an increase in cases of botulism from home-canned foods, because of the larger numbers of Victory gardens and the subsequent home canning of foods. Between 1922 and 1941, there were 36 cases, with 14 deaths in upstate New York. The department urges consumers of home-canned foods to boil them for at least fifteen minutes after removal from the containers. Data collected from the health departments of the New England states revealed that botulism[156] is rare in this region. From 1920 to 1942, there were no known cases or deaths due to botulism in any of the states except Connecticut, which reported 5 cases—2 in 1922, and 1 each in 1925, 1933 and 1942.

The United States Department of Agriculture bulletin entitled "Home Canning of Fruits, Vegetables and Meats"[157] contains detailed instructions not only for the correct handling and processing of foods, but also for their safeguarding against spoilage from *Cl. botulinum* and other dangerous bacteria.

Botulism can be prevented if home canning is properly performed. Special care must be taken in the immediate future because underprocessing of home-canned products may occur frequently now that home canning is stimulated by the rationing of commercially canned foods. Proper precautions must be taken by all canners, especially by those who are canning for the first time. The fruits and vegetables should be fresh and firm, and should be thoroughly washed, cleaned and canned as soon as possible after harvesting. Non-acid food such as vegetables, meat, poultry and fish should be processed in a pressure cooker, according to Faust,[158] of the United States Department of Agriculture. If a cold-pack method is employed in home canning, the food should be reboiled for ten to fifteen minutes before tasting or eating. Canned food that is foul in odor, has an off or sharp taste, or gives off gas on being opened should be discarded, preferably without tasting, since the toxin is extremely powerful and may cause severe illness even in minute doses.

Staphylococcal Poisoning

Dack[2] states: "Staphylococcus food poisoning, like botulism, is produced by a toxin formed in the food before ingestion. It is probably the most common of all food poisonings, although we have no knowledge of the number of cases occurring annually, since it is not reportable." The enterotoxin is heat-stable, even after boiling for thirty minutes, and chlorine in palatable amounts is not effective in destroying it.

The literature on staphylococcal food poisoning is profuse. The laboratory procedures and the characteristics of the enterotoxin are described by numerous authors.[159–165] Dack[166] describes some of the laboratory procedures that can be used to determine whether the strain of *Staph. aureus* concerned is one that can produce enterotoxin. Not all staphylococci give rise to food poisoning; however, if *Staph. aureus* is found in abundance in a suspected food, this is presumptive evidence that it is the offending agent. Final proof of whether the isolated strain is a food-poisoning type rests on animal experimentation.

It is often found desirable to classify a strain of Staphylococcus in order to obtain positive evidence in an outbreak. If specimens that are isolated from the food, from the food handler and from the vomitus of patients are identical, this is the best proof of the sequence of the outbreak. Durfee[167] classified 110 strains and describes methods that are employed in this procedure, such as agglutinative and polysaccharide-forming qualities.

Favorite and Hammon[168] studied the production of staphylococcal enterotoxin and alpha hemolysin in a special medium, a procedure that is useful in determining the toxicity of strains isolated from food-borne outbreaks. Hammon[169] describes a practical intravenous cat test for the evaluation of staphylococcal enterotoxin. This method is adaptable for use in large public-health laboratories.

Although numerous outbreaks due to the organism have been described, only a few will be cited. Geiger and Crowley[170] report an outbreak due to commercially prepared egg-and-olive sandwiches contaminated by a carrier. Chason and Waite[171] studied one due to buttermilk. Dorling[172] tells how an elderly woman infected a can of soup

from a whitlow of the left thumb. The soup was left standing at room temperature for seven days, then heated and eaten. Three hours later the woman became ill, with vomiting and diarrhea, and died on the same day. A strongly hemolytic, coagulose-positive strain of *Staph. aureus* was isolated from the empty can and from the stomach and intestinal contents. In Worcester, Massachusetts,[173] a woman prepared soup from a dehydrated mix and left it standing for twenty-eight hours; it was then heated and eaten by the woman and her granddaughter. Both were ill with severe nausea, vomiting and diarrhea three hours later. *Staph. aureus* was isolated from the left-over soup. Two other packages of the same lot of dehydrated soup were free of staphylococci.

Coughlin and Johnson[174] reviewed 17 staphylococcal outbreaks, with 1227 cases, between 1935 and 1939 in upstate New York. All were traced to cream-filled pastry. Five of the outbreaks, responsible for 60 per cent of the cases, were from a single bakery. Chocolate éclairs and cream puffs were most commonly involved, and contrary to popular belief, the outbreaks occurred in the colder months as well as during the summer. The authors recommend the rebaking of filled pastry and prompt sale as methods of control. The New York State Department of Health reported the following recent food poisonings due to staphylococci. Twenty-eight patrons of a first-class restaurant in an upstate city became ill five hours after a meal, with profuse vomiting, diarrhea and marked prostration. The vehicle was hollandaise sauce, which is made from butter, egg yolks, lemon juice, water and salt. Sixteen persons in New York City were served a dinner at a hotel in March, 1942. From three to eight hours later, all but one became ill with diarrhea, cramps, nausea and vomiting, which lasted for two to three days.[176] The only person who was not ill had not eaten hollandaise sauce. The sauce had been prepared at 10 a.m. the day of the dinner and had been kept on the steam table until ready to use at 8 p.m. Two persons who ate the sauce at noon and a third who ate it between 5 and 6 p.m. were not made ill. The department urges scrupulous cleanliness in preparing and handling hollandaise sauce and other foods of this nature. Over 165 persons, principally nurses and employees of a large upstate general hospital, became ill with an explosive onset of gastrointestinal symptoms six hours after eating turkey salad.[177] The meat used had been left over from roast turkey served forty-eight hours previously. Laboratory examination demonstrated a hemolytic *Staph. aureus* in large numbers, both in the salad and in the meat from which it was prepared. Twenty persons, employees of an upstate industrial plant, became ill with nausea, vomiting and diarrhea after eating cream-meringue pie at the plant cafeteria.[178] The pies were approximately eighteen hours old when the first person was served. The manner in which the pies were infected was not determined.

In Worcester, Massachusetts, 180 persons in a large war industry became ill with nausea, vomiting, chills and prostration following a meal in the plant cafeterias.[179] The same strain of *Staph. aureus* was isolated from the throat of a food handler, from the ham served the employees and from the vomitus of one of the patients. The ham had been kept at 90°F. for four to six hours in thermos containers.

During July, 1941, 71 cases of staphylococcal poisoning occurred in nineteen families. Terzich[180] traced the source as improperly pasteurized milk sold by two retail milk dealers. Geiger[181] reports an outbreak in California in which there were 110 reported cases in twenty-eight families. The patients became ill after eating cream-custard cakes from a single bakery. The sanitary facilities there were highly inadequate, giving ample opportunity for the ubiquitous staphylococcus to contaminate the custard.

Two interesting outbreaks are reported from Hamilton, Ontario, by Roberts, Deadman and Elliot.[182] Twenty-one persons in five families ate a custard-filled pastry purchased from a bakery. All the employees of the bakery were carefully examined, and cultures were taken. *Staph. aureus* was isolated from 4 employees, from cream pie, lemon roll and vanilla slices and also from jam pails, pastry bags, and milk from a can in the bakery. The same bakery was involved in another outbreak two months later, when there were 8 persons ill in four families. Wilson[183] studied the organisms isolated from this bakery. The staphylococcus persisted in the nose and throat of the employees of the bakery for three weeks, but was absent six weeks after the outbreak. In 1941, Hamilton had another outbreak of staphylococcal food poisoning. A butterscotch pie baked in the restaurant where it was served was incriminated. Staphylococci were obtained from the pie, the pastry-bag tip and the vomitus of a patient. From studies by Wilson,[184] these strains and one isolated from the baker were found to be identical. The same author[185] has described the symptomatology, differential diagnosis and treatment of staphylococcal food poisoning. The signs and symptoms vary only slightly in degree. Onset is rapid and occurs from one to five hours after ingestion of the contaminated food. The symptoms are dizziness, nausea, abdominal cramps and vomiting, lasting usually only a few hours but in

severe cases several days. The temperature is usually normal, the pulse is increased, and there are frequently cold sweats. Diarrhea may occur simultaneously with the vomiting or be delayed for several hours. Patients may become markedly dehydrated. (In an autopsy on a patient who died from acute staphylococcal food poisoning, the outstanding finding was an extensive and marked lack of body and tissue fluids; an adequate fluid intake might have saved the patient's life.) The acute symptoms generally last only a few hours, but in severe cases there is prostration and recovery may be delayed for several days. During this period a temperature of 100°F. is not unusual. In Salmonella infections, the onset is usually delayed for twelve hours or more, and fever is not an uncommon finding. These are the two most important characteristics whereby staphylococcal food poisoning can be differentiated from Salmonella infection. The treatment is symptomatic, and in severe cases is essentially that of shock and dehydration, which may become quite marked.

Slocum[186] discusses the differentiation of staphylococcal and Salmonella food poisoning. In the former the incubation period is short, usually two to four hours, and the onset is characterized by abdominal cramps or pain, nausea, vomiting and diarrhea. Fever is not a usual finding. The duration averages six to eight hours and recovery is rapid. In Salmonella infection, the incubation period is six to twenty-four hours and fever is common. The duration is much longer and recovery is delayed for days. Slocum states that Salmonella infection is commoner in Europe than staphylococcal food poisoning, whereas in the United States the reverse holds true.

Chemical Poisoning

Food-borne chemical poisoning is comparatively rare as contrasted with staphylococcal food poisoning. However, the clinical syndromes of these two types are closely similar. Both are characterized by a short incubation period. The onset of nausea, vomiting and diarrhea is sudden. Sweating, abdominal cramps and a normal or subnormal temperature are characteristic in both. In cadmium or fluoride poisoning, the incubation period is usually somewhat shorter. The only way, however, to distinguish between these two food poisonings is by analysis of the vomitus and the suspected foods. The chemicals most likely to be found in food are fluorine, cadmium, arsenic and chemical refrigerants, such as methyl chloride, escaping from defective mechanical refrigerators. Dack[2] lists the various chemical poisons and the characteristics of the gastrointestinal upsets that follow their ingestion.

In Massachusetts, an outbreak was traced to a discharged employee who added sodium fluoride insecticide to corn-meal batter in a grudge against his employer.[187] There were no fatalities. Lidbeck et al.[188] describe an acute sodium fluoride poisoning involving 263 cases and 47 deaths in a mental hospital in Oregon. Sodium fluoride was added to scrambled eggs by a patient who confused a barrel of sodium fluoride, an insecticide, with one of powdered milk. Many of the inmates did not eat the eggs because of the bad taste. The incubation period was short, the chief symptoms being nausea, vomiting and diarrhea, leading to collapse. Where patients were ill over a longer period of time, the pupils became dilated, the pulse was thready, respirations were shallow and unlabored, the heart tones were weak, and the skin was cold, moist and cyanotic. Other symptoms were paralysis of the muscles of deglutition, carpopedal spasm and spasms of the extremities.

In a New York reform school, 69 of 96 persons who ate chocolate pudding for dessert suddenly became ill with nausea, followed by repeated vomiting, severe cramplike pain in the epigastrium and later by one or two loose movements.[189] Weakness and sweating were prominent symptoms. Headache, salivation and lacrimation were present. The temperature was normal or subnormal. Investigation revealed that an inmate kitchen helper had added a handful of roach powder containing sodium fluoride to one hundred gallons of chocolate pudding. The amount of sodium fluoride varied in different samples of the pudding, ranging from 0.1 to 0.3 per cent. Since a serving consisted of 200 gm. of pudding, each patient ate 0.2 to 0.6 gm. of sodium fluoride, an amount that is below the lethal dose of 3 gm. Legislation has been passed in New York State requiring the coloring of all fluoride containers and insecticides by prescribed dyes. Similar requirements should exist in all states.

Recently, cadmium poisoning has become prevalent as a result of the replating of metal food utensils with alloys containing this metal. The United States Public Health Service[190] has prepared a special bulletin on this subject. In New York, according to Coughlin and Johnson,[191] between 1938 and 1941 4 outbreaks of cadmium poisoning occurred, 3 of these from acid foods prepared in cadmium-plated food utensils, and 1 from ice cubes in a cadmium-plated tray in a leaky refrigerator where the escaping refrigerant dissolved some of the cadmium. As a result of these outbreaks, the use of cadmium in the replating of food utensils is no longer permitted in New York.

Cangelosi[192] describes 3 outbreaks, with 208 cases, in the Fleet Marine Force operating in the

Caribbean in 1941. The principal findings were abdominal pain, nausea, vomiting, normal or subnormal temperature, sweating and headache. Recovery was rapid. All the patients drank coffee or lemonade made in cadmium-plated containers. Treatment consisted of the administration of warm water to encourage emesis, and, for those more severely ill, bismuth subnitrate and paregoric to control diarrhea. Measures were instituted to stop the use of cadmium in metal food containers. Frant and Kleeman[193] report 50 cases in 5 outbreaks, all due to drinking an acid liquid prepared in cadmium-plated containers.

Coughlin and Johnson[191] cite the occurrence of several outbreaks of similar food poisoning in a number of hotels in the same area. Investigation revealed that these institutions were using the same brand of silver polish, which, analysis showed, contained sodium cyanide. This chemical can no longer be used in silver polish in New York.

Cox[194] points out that the use of insecticide or spray on fruits and vegetables carries a distinct danger because the chronic effects of continued ingestion of the lead, arsenic or fluorine in the liquid may result in illness. Prevention of this poisoning, he states, may be achieved by requiring that fruits be acid-washed or trimmed or otherwise conditioned so that they will reach the wholesale and retail markets with a legal tolerance of 0.05 gr. of lead, 0.025 gr. of arsenic and 0.02 gr. of fluorine per pound. The co-operation of growers, shippers and food inspectors is required in order to prevent chronic poisoning from insecticides and spray residues. Scott[195] discusses a case of arsenical hepatitis from spray residue on fruits and vegetables. Sampson[196] describes an outbreak of polyneuritis in South Africa due to the ingestion of triorthocresyl phosphate contained in cooking oil.

Shellfish Poisoning

Sommer and Meyer[197] describe a paralytic form of shellfish poisoning along the Pacific coast. The same type of disease has been reported from Nova Scotia, western Canada and Belgium. The poisoning is due to the presence of the dinoflagellate *Gonyaalax catenella*. The warm sun and the cold, nutrient waters along the Pacific Coast are responsible for an abundance of this organism in the summer. The poisoning is due to an alkaloid that is heat-stable in acid or neutral solutions but is gradually destroyed by boiling in alkaline solutions. One millionth of a gram is lethal for a mouse, and a few milligrams for man. The alkaloid is stored in the digestive glands of mussels and excreted over a period of weeks. The poison is not stored in the muscular tissue of the mussel. Ocean mussels and large varieties of clams on the West Coast, including the Washington and pismo types, have been incriminated. Since 1927, there have been 346 cases and 24 deaths from mussel and clam poisoning along the Pacific Coast from Alaska to Mexico; all the cases occurred between May 15 and October 15. In July, 1936, there was a mussel-poisoning outbreak in Nova Scotia with 2 deaths. The symptoms begin immediately after the mussels are eaten. A prickly feeling in the extremities and tongue is followed by numbness. An ataxic gait and muscular inco-ordination progress to ascending paralysis and death from respiratory paralysis in two to twelve hours. Gastrointestinal symptoms are rare, except in severe cases, where there may be vomiting. There is no known antidote. Suspected shellfish should be packed in alcohol and sent to a laboratory for analysis.

Methods of Control

The control of food-borne disease should be the concern not only of epidemiologists and other public-health officials, but also of all physicians, food handlers and citizens who wish to bring the war to a rapid and victorious end. Gastrointestinal diseases are a major cause of absenteeism in industry. McGee and Creger[198] determined that 18.6 per cent of 40,942 days of work lost by employees of a powder-company plant in New Jersey in 1941 were due to gastrointestinal disturbances. Of 5402 absences from work, 24 per cent were due to this group of diseases. Of the 7605 days lost from diseases of the digestive tract, 30.6 per cent were from gastrointestinal upsets and colon dysfunction and 4.1 per cent from enteritis and dysentery. Most of the absenteeism occurred early in the week — especially after week ends — and after holidays.

Food poisoning frequently disrupts large war plants. Moreover, the importance of dysentery among the military personnel cannot be overemphasized. The health officer, the industrial physician, the industrial manager, the food handler and the consumer himself play important roles in controlling food-borne disease. Underwood[199] states that one of the roles of public-health activity in the national emergency is to ensure "ordinary sanitation, safe water and milk supplies, protection of food supply, a sanitary method of excreta disposal and drainage." Boudreau,[200] speaking of epidemic hazards in war, emphasizes that they are dependent on the nature of the war and the diseases prevalent in the area, such as typhoid fever and the dysenteries in Russia and the Balkans.

Health officers[201] are expecting an increase in food-borne disease acquired in public eating places as a result of the war. More people are eating in restaurants because of the rationing of food

and the placing of women in industry. Increasing difficulties are being encountered in restaurants; the lack of responsible personnel trained in the sanitary and proper handling of food, the overburdening of kitchen facilities, the unavailability of proper equipment and in some cases short cuts and improper methods in food processing are the principal causes of the increase in food-borne disease.

Municipal health departments are the chief agents responsible for the sanitation of food establishments. As Korff[202] explains, the primary objective of food-establishment inspection is the prevention of food poisoning and infections transmitted by foods. This entails the co-operation of the entire food industry. Training of commercial food handlers is an accepted method of developing safe and sanitary procedures in restaurants and other food-handling establishments. Many municipalities have developed such courses. In Texas[203] the state has assumed this responsibility by means of itinerant instructors, and is convinced that the training is effective in improving the sanitation of establishments.

The perennial question of routine examination of food handlers always appears. In New York City, the finding of each typhoid-fever carrier by routine stool cultures of food handlers cost the city $50,000; therefore, the examination of food handlers was discontinued in 1934.[204] Fort Worth undertook routine examinations of food handlers, and expended $353.77 for finding each typhoid-fever carrier.[205] The local medical society finally concluded that it did not favor routine medical examinations of food handlers — the same conclusion that was reached in San Francisco. Most health authorities have now given up the idea of routine examinations of food handlers as impractical, and as involving an unjustifiable expense of funds that could be utilized for more effective methods of food control.

An important person in the control of food-borne disease is the consumer. The buyer must be aware of what sanitary and insanitary food handling means in relation to health.[206] The health authorities must arouse in consumers a desire to trade in shops where food is handled in a clean and sanitary manner. Public opinion is a powerful influence on the commercial food handler; the storekeeper will sell the buyer whatever he demands. When the public is taught to demand safe, clean and sanitary food, properly processed and handled, food-borne disease will be reduced to a minimum.

The elimination of unhealthy animals is one of the veterinary's contributions to the control of these diseases. McKim[207] lists forty-six causes for which meat may be rejected or condemned as unfit for human consumption. The public-health engineer or inspector can do much to track down the mode whereby food may have become infected during processing, and take necessary measures to prevent a repetition.[208] Fuchs,[209] senior sanitary engineer of the United States Public Health Service, outlines the needs of adequate restaurant sanitation and discusses the provisions of a recommended ordinance regulating food and drink establishments.[210] This ordinance, or regulations based on it, has been legally adopted in seventy-four counties and by one hundred and twenty-three municipalities in nineteen states. These regulations provide minimum standards for the operation of a licensed or graded food-handling establishment. Inspection of all restaurants is required at least once every six months. If violations of regulations are not corrected after notice in a reasonable time, temporary suspension of the license or degrading (publicly displayed) and, if necessary, hearings, court action and fines are the methods of enforcement.

Horwood and Pesare[211] made sanitary surveys of public eating places in Rhode Island and concluded that ignorance of accepted sanitary requirements and procedures as manifested by the managers and employees of public eating and drinking establishments is the most important single cause of insanitary practices in such places. The development of accepted sanitary procedures has been a concern of the Engineering Section Committee of the American Public Health Association, which publishes periodical reports on sanitary procedures, including standards for disinfection of dishes and utensils, evaluation of dishwashing machines, detergents and other aspects of food sanitation.[212]

Regulations applying to food-handling establishments must, as Tiedeman[213] points out, be reasonable and practical, and must be enforced simultaneously with the education of the food handlers. In the hand-washing of dishes, temperatures of 120°F. for the wash water and 170°F. for the rinse water, thermostatically maintained, are considered adequate. Enough detergent must be used to remove properly all types of materials, in a short time. Soap, alkali, phosphates, silicates and sulfated alcohols are some of the detergents evaluated by Gilcreas and O'Brien.[214] Alkyl-dimethyl-benzyl ammonium chloride is recommended by Krog and Marshall[215] as an efficient sanitizing agent for the cleaning of eating and drinking utensils.

The Food and Nutrition Section of the Amer-

ican Public Health Association[216] surveyed ten public eating establishments to study the effect of an educational program and to evaluate methods. Mechanical washing of drinking glasses and eating utensils is better than hand washing because standards are more easily set, the temperatures of the wash water and the rinse water are higher, and the procedure is more easily controlled. If proper procedures in the hand-washing of dishes are used and clean towels are available, the number of bacteria per utensil can be reduced.

One of the most effective methods of reducing food-borne disease is the enforcement of proper personal-hygiene practices by all food handlers. Strict enforcement of hand washing before handling food, and especially after visiting the toilet, will do much to reduce typhoid fever, Salmonella and Shigella infections. These diseases are usually spread from the food handler's fingers that have been soiled by his excreta. Keeping the hands away from the mouth and nose and covering the mouth while coughing or sneezing, followed by washing the hands, covering foods whenever possible, refrigerating those that are perishable, reducing the interval between cooking and eating, eliminating food handlers with purulent wounds, boils or infections of the hands, preventing food handlers with sore throats from preparing food — all these will reduce most of the chances of contamination.

Since custard-filled and cream-filled pastries are one of the commonest vehicles for the transmission of food-borne disease, much research has been carried on in an endeavor to make these favorite items of the American diet safe for the consumer. One of the methods for controlling the ubiquitous staphylococcus in such pastries is rebaking, as described by Stritar, Jungewaelter and Dack.[217] Fifteen bakeries in Baltimore are described by Korff[218] as using this procedure and finding it satisfactory. Gilcreas and Coleman[219] state that rebaking for fifteen minutes at 216 to 220°C. (420 to 428°F.) destroys staphylococci and has no effect on the palatability or appearance of the pastry. These authors recommend that larger pastries be rebaked for twenty minutes. There seems to be no doubt that rebaking pastry will effectively eliminate a large proportion of food-borne disease, for which pastry has always been a common vehicle. Staphylococci and Salmonella organisms, the two bacteria most frequently found, will thereby be destroyed.

Cathcart, Ryberg and Merz,[220] have studied methods of controlling *Staph. aureus* and *S. enteritidis* by various methods. Although ultraviolet light (2000 to 2950 angstrom units) effectively reduces the count of both organisms in the air and on smooth surfaces, it does not penetrate the surface of custard products; similarly, ozone has proved to be ineffective. Both methods produce an unpleasant odor after the prolonged exposure of custard-filled pastry. The growth of both organisms is effectively inhibited by the pH and the type of acid or other substances (lemon, orange, pineapple, apricot and strawberry) present in pure fruit fillings, if prepared by a special formula.[222] The addition of milk, which may act as a buffer to a fruit filling, reduces the inhibitory action. If lemon juice and grated lemon rind is added to a standard custard, there is no inhibition of growth until the concentration becomes so high that the product is unsatisfactory.

Natural chocolate and natural cocoa fillings prepared by a special formula, preferably without eggs, have an inhibiting action on the growth of *Staph. aureus*.[222] This effect seems to be due to the pH and to a combination of substances present in the nonfat part of chocolate and cocoa. Merely bringing custards to a second boil after the addition of the thickening mix renders them sterile to both *Staph. aureus* and *S. enteritidis*.

The utilization of special filling formulas, the proper sanitary handling of products, the boiling of custard or the rebaking of pastry, and the rapid utilization of the product should effectively decrease the number of food-borne outbreaks due to cream-filled and custard-filled pastries.

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CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

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CASE 29251

PRESENTATION OF CASE

First admission. A fourteen-year-old boy entered the hospital for treatment of a deformity of his knee.

The patient, who was a known hemophiliac, had injured his left knee during a strenuous ping-pong game nine months before entry. The patient had previously had frequent attacks of acute pain and swelling of the knees, ankles and right elbow, but on the following day the knee became more tender and swollen than it had ever been in the past. A flexion deformity resulted. This was straightened under anesthesia at a community hospital and a posterior cast was applied. When the cast was removed the contracture recurred and became progressively worse.

There was no history of hemophilia in any other member of his family.

Physical examination showed a thin, pale undernourished boy in no acute discomfort. There was a flexion contracture of 120° in the left knee, with a 20° flexion contracture of the right knee and a 40° flexion contracture of each hip.

Examination of the blood showed a red-cell count of 4,280,000, with a hemoglobin of 65 per cent, and a white-cell count of 11,100, with 74 per cent neutrophils. The urine was normal. The bleeding time was 4 minutes, and the clotting time 5½ hours. A blood Hinton test was negative.

X-ray films showed atrophy of the muscles and bones of the lower extremities, more marked on the left. There was a flexion deformity of the left knee joint, with calcification in the region of the joint capsule. Similar but less pronounced changes were present in the left ankle joint.

On the tenth day, under Evipal anesthesia, the left leg was gently manipulated and placed in a cast in approximately 80° of flexion. Because of a pressure area over the tendo achilles, the foot was not incorporated. Three weeks later the cast was removed. There was a 60° flexion, and the following day a new cast was applied. Ten days later another manipulation was performed, resulting in an extension of the knee to only 15° of flexion. The patient developed a left lobar pneumonia (Type 3 pneumococcus), which responded to sulfadiazine therapy, and was finally discharged three and a half months after entry. He was able to walk with the aid of a brace and crutches.

Second admission (ten months later). At the time of his discharge it was noted that the left great toe was slightly swollen. Since then there had been a gradual increase in the size of the left toe. Seven months before re-entry the swelling reached the size of a golf ball and then slowly subsided almost completely. Six weeks before re-entry, without antecedent trauma, the patient noted that it was difficult to get his foot into a shoe. He was taken to another hospital, where his foot was immobilized in a cast. On his return home, the toe began to grow much larger, without pain but with discoloration of the surrounding tissue.

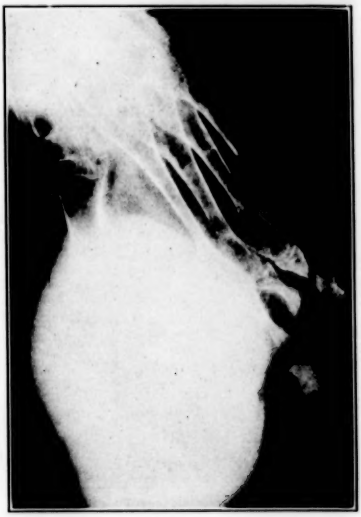

FIGURE 1. *Photograph of Foot.*

On examination the left great toe was almost completely replaced by a baseball-sized, nontender, bluish-red, somewhat fluctuant tumor (Fig. 1). The skin over it was tense and shiny. The left leg was fixed in extension.

*On leave of absence.

Examination of the blood showed a red-cell count of 3,370,000, with a hemoglobin of 65 per cent, and a white-cell count of 6800. The bleeding time was 2½ minutes, and the clotting time 6½ hours.

X-ray examination showed an extremely unusual soft-tissue swelling in the region of the left great toe, 11 cm. in length and 7 cm. in width, which displaced the terminal phalanx of the great toe

FIGURE 2. *Roentgenogram of Foot.*

forward and had destroyed the entire proximal phalanx and a part of the metatarsal bone (Fig. 2). Periosteal new-bone formation was seen along the remaining portion of the first metatarsal bone. There was definite evidence of external pressure on the second metatarsal bone, which was spread away from the first toe. Flecky calcification was present within the large soft-tissue mass. Examination of the chest was negative.

The patient was given numerous transfusions for the following two months until the clotting time remained at about 30 minutes; an operation was then performed.

DIFFERENTIAL DIAGNOSIS

DR. GRANVILLE A. BENNETT*: We have the story of a boy who is said to have been a hemophiliac. I presume that we can accept that diagnosis despite the negative family history. There is no history of repeated or prolonged bleeding unless we assume that the previous joint manifestations were caused by intra-articular hemorrhages. The coagulation time was prolonged. Obvious swelling of one joint following injury and the story of rapidly occurring articular swellings at previous times seem to me to be perfectly consistent with the picture of hemophilia. The joints that were involved are the ones most likely to be affected in this disease.

It is stated in the history that the leg was straightened under anesthesia in a community hospital. This procedure is considered hazardous and likely to cause additional intra-articular injury with more extensive hemorrhage. Manipulations, if carried out at all, should be of a most conservative type.

May we see the x-ray films taken on the first admission?

DR. RICHARD SCHATZKI: This is apparently the only film of the knee. It was taken when the knee was flexed in a cast. Because of the flexion one cannot judge the size of the joint space, but there is irregular destruction of the joint surfaces, in addition to marked decalcification of all the bones that appear in the film.

DR. BENNETT: Do you pay any attention to that area just above the epiphyseal line? Might that be a fracture?

DR. SCHATZKI: It is difficult to tell because the bone is decalcified and there is a cast on top of it. I think it is possible that there was a fracture on one side. I do not believe that it went all the way through.

DR. BENNETT: It seems to me that this x-ray picture is entirely consistent with hemophilic arthritis. The changes are caused by repeated intra-articular hemorrhages, followed by organization of blood clots and invasion of the cartilage by granulation tissue.

Ten months after discharge the boy returned with a large, baseball-sized, bluish-red, somewhat fluctuant tumor in the left great toe. It is stated that the tumor enlarged to the size of a golf ball, and then practically disappeared. These fluctuations in size suggest that the material responsible for the swelling was absorbable, most likely blood.

May we see the x-ray films of the foot?

DR. SCHATZKI: Here is the soft-tissue mass, with complete destruction of the proximal phalanx and partial destruction of the metatarsal. Here you see the tremendous displacement of the distal end

*Professor of pathology and bacteriology, Tulane University of Louisiana School of Medicine.

of the great toe. There is a mistake in the record, because there is no evidence of calcification in the soft tissue.

DR. BENNETT: May I ask about the type of destruction in the metatarsal bone? Am I correct in thinking that this is not the usual type of destruction that one sees in a neoplasm growing from within a bone? It looks more like atrophy or lysis of the bone rather than the type of destruction that occurs with an invading neoplasm.

DR. SCHATZKI: The defect in the distal end of the first metatarsal looks like a pressure defect rather than one produced by invasion.

DR. TRACY B. MALLORY: This colored picture of the boy's foot is a little dark, but you can see the deep-purplish swelling of the great toe.

DR. BENNETT: The appearance of the swelling and the x-ray changes indicate an unusual lesion. The color and the fluctuant character of the tumor suggest that it contained fluid and, in a hemophiliac one thinks of an extravasation of blood. If this lesion were not in a hemophiliac, the size and duration of the lesion would certainly suggest a rapidly growing neoplasm. It seems to me, therefore, that we must consider the possibility of a neoplasm whose rapid increase in size may have been due to hemorrhage. An alternative possibility is hemorrhage into the joint, with destruction of the adjacent bones because of pressure. The statement that this was a painless and nontender lesion suggests to me that there may have been some underlying lesion of which we have not been informed. If a neurologic examination was made, I wonder whether the findings were pertinent.

DR. MALLORY: No specific neurologic examination was made.

DR. BENNETT: The reason I ask is that there is a story of marked atrophy in the muscles of this leg and of a pressure sore over the ankle. I also note that the lesion itself was painless and nontender despite the extensive involvement.

DR. ROBERT KAISER: The abstract is incorrect, inasmuch as the mass was painful. The weight of the foot hanging down was painful, and it had to be supported with a cast.

DR. BENNETT: To explain this lesion on the basis of hematoma is difficult. That so much bone could have been destroyed because of pressure is scarcely believable. The size of the lesion and its general appearance suggest tumor as the underlying lesion. As my first choice I suggest that the underlying lesion was a neoplasm, but in order to explain the other changes, it must have been an unusual type of tumor, possibly beginning in the metatarsal articulation. One possibility is a synovial tumor, a synovioma. Such a tumor has a tendency to grow rapidly, and in a hemophiliac, it might enlarge extremely rapidly because of hemorrhage. The only other tumor that I should consider seriously is a destructive type of osteogenic sarcoma. The commonest tumor in this location is a chondroma, benign and slowly growing. Such a tumor should have been confined to a single bone rather than spreading across the joint line. My second choice is a hemarthrosis that had caused a marked degree of bone destruction through pressure atrophy.

DR. J. H. MEANS: What happened to the knee?

DR. MALLORY: I imagine that attention simply became directed toward something else. What do you think about the diagnosis, Dr. Means?

DR. MEANS: I think it could be explained on the basis of hemophilic arthritis. There is a marked degree of bone atrophy, and a good deal of destruction of the joint surfaces, both of which, to me, are entirely consistent with hemophilic arthritis.

CLINICAL DIAGNOSIS

Hemophilic hemarthrosis?
Malignant tumor of great toe?

DR. BENNETT'S DIAGNOSIS

Malignant tumor of great toe (synovioma or osteogenic sarcoma)?
Hemophilic hemarthrosis, with unusual degree of bone destruction?

ANATOMICAL DIAGNOSIS

Hemophilic hemarthrosis.

PATHOLOGICAL DISCUSSION

DR. MALLORY: It was believed on the ward that this was a desperate situation. A neoplasm could not be ruled out on clinical grounds; in fact, it might well have been present. There appeared to be no possibility of the patient's recovering the use of his foot in any case. Although no one had any great enthusiasm for operating on a boy with an extremely prolonged clotting time, it was believed that amputation should be done. He was given a series of transfusions in rapid succession, which brought the clotting time down to 30 minutes. Amputation was done through the ankle joint, and to everyone's surprise, I take it, there was no particular difficulty or great degree of bleeding.

The resected specimen showed a massive hemorrhage into the joint and surrounding tissues, with varying degrees of organization but no tumor. All the process was evidently hemophilic.

For several days following the operation the patient was mentally confused, which suggested the

possibility of subarachnoid or cerebral bleeding. Again, no one was enthusiastic about doing a lumbar puncture, and since after about a week it showed signs of spontaneously clearing up, the central nervous system was left uninvestigated. To everybody's surprise and relief, it was possible to get the boy out of the hospital.

CASE 29252

Presentation of Case

First admission. A twenty-seven-year-old housewife entered the hospital because of vaginal bleeding and cramps of four days' duration.

During the seven years prior to admission the patient noted an intermenstrual vaginal discharge that was foul smelling, white or yellow, and at times required a pad. She often had low back pain. Twelve days prior to admission she entered a community hospital where dilatation and curettage revealed a "hypertrophied lining"; a "cervical polyp" was cauterized. Following this she had a slight, "pink" vaginal discharge until four days prior to admission when she began to flow profusely. Two days prior to admission she developed severe lower abdominal cramps most marked on the right and occasionally radiating down the front of the thighs. She passed large blood clots and required pads every one and a half hours during the next two days.

The menarche occurred at thirteen years, the periods were regular, with an interval of twenty-five to twenty-nine days, and each lasted four to seven days. During the first three days abdominal cramps were severe and frequently required bed rest. The patient occasionally had intermenstrual bleeding not associated with pain; this occurred about two weeks after menstruation, lasted one day and required a pad. The last normal menstrual period began twenty-three days prior to admission. She had been married four and a half years but no pregnancies had occurred, although no precautions had been taken.

The family and past histories were not remarkable.

Physical examination revealed a well-developed and well-nourished woman. The heart, lungs and abdomen were normal. There was profuse uterine bleeding. The cervix was large, patulous, soft, ragged and bleeding. The uterus was small, slightly tender and pointed anteriorly; the vaults were negative.

The blood pressure was 126 systolic, 72 diastolic. The temperature, pulse and respirations were normal.

Examination of the blood revealed a red-cell count of 3,780,000 with a hemoglobin of 11.6 gm. and a white-cell count of 8400, with 68 per cent neutrophils. The sedimentation rates were 4, 16, 27 and 38 mm. in fifteen, thirty, forty-five and sixty minutes respectively. The urine gave a + test for albumin, and the sediment contained many red cells, 15 to 20 white cells and an occasional epithelial cell per high-power field. Cervical cultures were negative for beta-hemolytic streptococci.

The temperature gradually rose after admission and reached 101°F. on the third hospital day. She was treated with sulfadiazine by mouth, and the temperature promptly became normal. Vaginal packs controlled the bleeding, and the patient was discharged somewhat improved on the ninth hospital day.

Second admission (seven months later). Following her previous entry she stained for five to sixteen days before her expected periods and frequently had an intermenstrual creamy vaginal discharge. About six weeks before re-entry her physician started a routine sterility investigation, and about one month later insufflation of the tubes and an endometrial biopsy were performed. The latter showed proliferative endometrium. Nine days before re-entry another endometrial biopsy revealed secretory endometrium. Two days later she started to flow, although this was only the twenty-fourth day since the beginning of the previous menstrual period. During the week prior to admission the temperature varied from 100 to 101.4°F. and she had crampy pain in the lower abdomen and nausea but no vomiting. Bleeding was profuse and required fifteen to twenty pads a day. During the six days prior to admission she was forced to go to bed. She was slightly constipated. There were no urinary symptoms or chills.

Physical examination disclosed a pale, slightly apprehensive woman who was perspiring freely. The heart and lungs were normal. The abdomen was slightly distended and diffusely tender, with the chief locus of tenderness over the right lower quadrant, where a mass could be made out. One examiner demonstrated rebound tenderness, particularly in the right lower quadrant. Rectal examination revealed a fusiform mass in the right vault, a large patulous cervix that seemed softer than normal and a uterus that was larger than normal. The pelvic examination confirmed these findings, and fresh and clotted blood was found in the vagina.

The blood pressure was 110 systolic, 65 diastolic. The temperature was 100°F., the pulse 120, and the respirations 28.

Examination of the blood revealed a red-cell count of 3,240,000 and a white-cell count of 9850. The sedimentation rates were 7, 38, 46 and 50 mm. in fifteen, thirty, forty-five and sixty minutes respectively.

An operation was performed several hours after admission.

Differential Diagnosis

Dr. Joe V. Meigs: When I read this history the first thing I thought of was an abortion with moderate infection. There is nothing about the patient's temperature until the latter part of the history, when we find that she did have slight fever. The vaginal discharge is probably irrelevant. She may have had a trichomonas infection or endocervicitis; but I do not believe it is important. The abdominal cramps radiating down the thighs also suggest an abortion. Because of the early right-sided pain, cellulitis on the right side should be considered.

Regular intermenstrual pain is not unusual at the time of ovulation. The patient had been married four and a half years and had never been pregnant, but the possibility is always present.

The cervix was large, patulous, soft, ragged and bleeding. That could have been because the patient was pregnant or because she had been recently operated on, with cauterization of the cervix. The fact that the uterus was small makes one wonder whether, if she were pregnant, the pregnancy was outside the uterus.

The white-cell count is not consistent with infection. The urine was probably not a catheter specimen, hence the cells in the sediment are unimportant. Infection of the cervix or uterus was apparently suspected because cultures were taken, which were negative for a beta-hemolytic streptococcus.

Without curettage the patient quieted down and there was no need to do anything further. No dates are given, but the history indicates that she was going through normal periods before the second admission. I should like to learn whether the endometrial biopsy showed any evidence of decidua. Do you know, Dr. Sniffen?

Dr. Ronald C. Sniffen: It did not.

Dr. Meigs: The story at the time of re-entry makes one think of the interruption of an early uterine pregnancy — possibly by means of the endometrial biopsy — or of an extrauterine pregnancy.

One must consider whether she had acute appendicitis, but that does not seem to fit in with the picture. The white-cell count was too low for a serious infection.

The fact that operation was performed several hours after admission certainly makes me think of an acute abdominal lesion, such as a twisted ovarian cyst or an extrauterine pregnancy, or that she was bleeding sufficiently to make the gynecologist believe that she ought to be curetted.

Was a Friedman test done?

Dr. Benjamin Castleman: No.

Dr. Meigs: I am unable to make a clear-cut diagnosis, but I believe that the patient had either an incomplete abortion with moderate infection in the uterus and pelvis, a twisted ovarian cyst or an extrauterine pregnancy. She had an infection, and the first entry was probably for an abortion, and the subsequent one for an extrauterine pregnancy, that being why she was operated on.

Dr. Fred Simmons: We were not at all sure what this patient had, although our preoperative diagnosis was ectopic pregnancy. She was seen in consultation with an obstetrician, who agreed with our tentative diagnosis and thought that exploration was indicated. At operation the pelvis was found to be extensively involved with endometriosis. The right tube and ovary were involved in a dense mass of adhesions, which included the appendix. The appendix was of normal size, definitely red, indurated, and kinked and was covered with fibrin at the site of the kink, which was suggestive of acute appendicitis. Because the patient was very anxious to have children we were conservative. The appendix was dissected away from the tubo-ovarian mass with some difficulty and only a portion of the right ovary was resected. The left adnexa appeared normal and were left intact. There was no ectopic pregnancy.

Dr. Meigs: I think my reasoning would be just the same now that I know I was wrong. I certainly thought of appendicitis but I see no reason why I should have concluded that she had it.

Clinical Diagnosis

Extrauterine pregnancy?
Tubo-ovarian abscess?
Twisted ovarian cyst?

Dr. Meigs's Diagnoses

Extrauterine pregnancy?
Early abortion?
Twisted ovarian cyst?
Pelvic infection.

Anatomical Diagnoses

Acute appendicitis.
Endometriosis of appendix and right ovary.

Pathological Discussion

Dr. Castleman: The appendix was covered with fibrin, and on microscopic examination, in addition to the acute infection of the serosa and muscularis, there was extensive endometriosis throughout the serosa. The ovary also showed endometriosis. Dilatation and curettage, which were also performed, showed that the endometrium was in the secretory phase, without any suggestion of decidua.

Dr. Simmons: We debated whether to do the dilatation and curettage before laparotomy but decided not to because we thought we had to explore in any event. After exploration we still could not explain the profuse uterine bleeding and therefore did the dilatation and curettage.

Dr. Castleman: Do you think, Dr. Meigs, that the abnormal bleeding could have been due to the diffuse endometriosis throughout the pelvis?

Dr. Meigs: This patient had marked endometriosis, but one does not see many patients with endometriosis with bleeding as severe as this. I could not make that diagnosis.

Dr. Simmons: The patient made an uneventful convalescence, and the subsequent periods have been normal.

Dr. Joseph Aub: What about the leukorrhea?

Dr. Simmons: No trichomonas were found, and cultures of the cervix were negative. I think that leukorrhea can occur on a nervous basis, and perhaps this patient falls into that class.

Dr. Meigs: I have seen flare-ups of pelvic inflammation in patients who have had insufflation of the tubes and endometrial biopsy. Following any manipulation in the endometrial cavity one occasionally sees moderate intrapelvic inflammatory disease. It is rare, of course, but this might have been responsible for the second flare-up.

Dr. John Rock: Do you not suppose the mucoid disturbance was due to a hyperactive cervix? If it was mucoid, it must have come from the cervix, not the vagina; if purulent, it must have meant endocervicitis. We naturally expect to be able to see an endocervicitis that causes profuse leukorrhea. Probably the only way to cure such a patient is to cauterize the cervix, thus getting rid of the hyperactive mucous glands. If that does not result in cure, a repeated series of sulfa drugs sometimes clears up what is left. I have seen cases of profuse leukorrhea in which the cervices were apparently normal; however, the deeper glands of the cervix were chronically infected and hyperactive.

Dr. Meigs: Was not the sedimentation rate rapid, Dr. Beckman?

Dr. William Beckman: Yes.

Dr. Meigs: That is one of the differential diagnostic points we raise between appendicitis and acute salpingitis. In cases of salpingitis the sedimentation rate is usually rapid, whereas in cases in which the appendix is ruptured it is not. Here is one case of appendicitis in which the sedimentation was rapid.

Dr. Francis Ingersoll: In the Emergency Ward, we formerly used the sedimentation rate to differentiate salpingitis and appendicitis, but when Dr. Roy Cohn carefully checked these cases, he found many cases of appendicitis with rapid sedimentation rates.

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"MASTERY OF THE AIR"

The course of the present war has illustrated the importance of "mastery of the air" in gaining victory over our enemies in combat. Other almost equally important enemies behind the battle lines and on the home front, which are responsible for many deaths and casualties in wartime and which must be conquered, are epidemics of respiratory infections. Although the final victory over the latter enemies is still far off, the weapons are now being forged that may lead to this victory. Some of these weapons are concerned with the attempt to gain mastery of the air by controlling its content of disease-producing viruses and bacteria. This, it is hoped, will reduce or eliminate the so-called "air-borne infections," which include not only those of the respiratory tract but also certain types of wound infections.

During World War I extensive studies were carried out, particularly in army hospitals, on the mode of spread of respiratory and wound infections. At that time the importance of air-borne infectious agents was recognized. Since the chief offending organism at that time was the hemolytic streptococcus and since the most important mode of spread was by way of the human respiratory tract, some attempts were made to control such infections in hospital wards. These methods involved general cleanliness, proper spacing, screening and the masking of patients and personnel.[1]

The opinion is now widely held that respiratory infections are spread through the air directly by droplets laden with organisms that are expelled from the infected respiratory tract and by "droplet nuclei," which are minute particles resulting from the evaporation of the relatively large droplets. These nuclei bear virulent organisms but they are small enough and light enough to remain suspended in the air for considerable periods, during which they may be inspired by other persons and thus produce spread of the disease. Direct infection of contacts may, of course, take place by means of droplet infection. Turner, Jennison and Edgerton,[2] of the Massachusetts Institute of Technology, have made extensive studies of such droplets as they are expelled during coughing and sneezing. By means of specially perfected high-speed photography utilizing strong indirect illumination, they have been able to visualize these droplets and have shown that tremendous numbers are expelled during the act of sneezing and that smaller, yet considerable, numbers are ejected by coughing and speaking. Many of the large particles tend to fall rather rapidly, but in a significant number, evaporation takes place rapidly and results in small particles that may serve as germ-carrying droplet nuclei. Their studies emphasize the importance of controlling the spread of the droplets during sneezing, especially by persons suffering from the acute stage of a common cold.

Most of the common respiratory pathogens have been recovered from the air, particularly in

hospital wards where infected persons are being nursed or where there are large congregations of persons.[3] The numbers of such bacteria that are recovered during epidemics of respiratory infections are large and significant, and the possibility of spread of air-borne infections has acquired great significance because of the concentration of persons in places of amusement or other indoor assemblies, in industrial plants, in military barracks, on ships, in hospital wards and in air-raid shelters.

The earlier methods of studying the number of pathogenic bacteria found in the air involved exposing plates containing suitable culture mediums in various strategic locations and counting the number of colonies after these plates had been exposed for a desired period and properly incubated. Other methods and apparatus for obtaining samples of air and subjecting them to bacterial counts have been devised, the most elaborate of which is the Wells centrifuge. The later methods offer a better means of evaluating the number of bacteria suspended in the air in contrast to those that sediment onto the surface of exposed culture plates. All these procedures have been used in the evaluation of newer methods that are designed to reduce or eliminate infection of the air.[4]

Wells and his co-workers[5] have been interested in the utilization of ultraviolet radiation as a means of reducing or eliminating air-borne infection in enclosed areas. The studies made by Hart[6] at Duke Hospital offer fairly convincing evidence that ultraviolet radiation may bring about a considerable reduction in wound infections following surgical operations. In hospital wards, particularly those for children with communicable diseases, lamps have been installed to produce a barrier of ultraviolet light through which air and its contents pass from the potentially infected atmosphere of the infected patient's cubicle into the rest of the ward.[7] In this manner some evidence has been gathered to suggest that the incidence of cross infections, even of such a highly contagious disease as chicken pox, can be markedly reduced. The enthusiasm of some of the workers in this field, however, is not universally shared by other observers. Objections have been raised both to the interpretation of the results and on the grounds of the difficulties involved in properly equipping and maintaining the necessary apparatus, as well as in protecting patients and staff from the untoward effects of overexposure. These objections have deterred the majority from adopting this method of control. Thus far there have been no large-scale studies in which ultraviolet radiation was employed, or if they have been made, the results are not available to permit an evaluation of its practicability.

A second method of control of air-borne infections involves chemical disinfection of the air. Most disinfectants that in the past have been found effective in killing bacteria in the atmosphere have not proved useful because of certain undesirable properties, particularly their high toxicity when inhaled in the concentrations necessary to produce the desired result. Investigations carried out over a number of years by Trillat[8] in France, then more recently by British workers,[9] and in the past few years by Robertson and his co-workers[10] in Chicago have resulted in the discovery of certain aerosols that, when sprayed or vaporized, are highly effective in rapidly disinfecting the atmosphere. Propylene glycol is one of the substances that has been tried extensively, and Robertson and his co-workers have found it to be the most effective and the least toxic. This substance in a concentration of one part in two to four million produces rapid sterilization of air containing fairly large numbers of the common pathogenic bacteria, and is also effective in destroying virulent influenza virus. Even in a dilution as high as one part in fifty million, it is able to reduce to a considerable extent the number of bacteria. Since more concentrated amounts of this substance can apparently be inhaled by animals for long periods without deleterious effects, its toxicity is low. Furthermore, bactericidal concentrations can readily be obtained by simple means involving either mechanical spraying or evaporation at suitable temperatures. The mechanism by which these substances operate appar-

ently involves a coating of the droplet nuclei by the aerosol, which condenses on the surface and results in death of the bacteria.

Many problems remain to be solved, and extensive studies are being carried out in an attempt to work out the details of this method and its applicability. It must be ascertained to what extent the materials, in the concentrations in which they must be used, are inflammable or explosive; whether or not they are toxic when inhaled in these concentrations for long periods; and what is the effect of variations in temperature and humidity. Up to the present time their use, too, has not been tested on a large scale and under conditions of crowding and mass infection, such as are likely to prevail on troopships, in air-raid shelters or in other similar situations, particularly during the course of epidemics of respiratory infections. Further studies with aerosols and with other germicidal substances are being carried out both in this country and in Great Britain.

A third factor of importance in the spread of respiratory infections and in the contamination of wounds in operating rooms or hospital wards is related to dust. Experiments carried out in England have shown that the number of pathogenic bacteria that can be recovered from the air in a hospital ward varies markedly in different parts of the day.[11] The largest numbers are found in the morning hours during and after the time when the beds are made and the wards are cleaned. These counts correlate directly with the counts of the numbers of dust particles. Furthermore, numerous studies in the past have shown that the dust of rooms in which patients with respiratory infections are nursed contains large numbers of virulent bacteria similar to those found in the patients. Control of dust is, therefore, another significant factor in the reduction of air-borne infection. The British studies have led to specific recommendations for this purpose. These involve the avoidance of dry dusting and the substitution of wet mopping, which in turn involves the use of suitable flooring material for this purpose. More specifically, the use of liquid paraffin films has been recommended for floors and for blankets, bedspreads and other linen articles that contribute to the dust of the sick room. When treatment with liquid paraffin or other suitable oils is properly carried out, an invisible surface film is produced that apparently does not have much effect on the appearance of the flooring and linens and does not alter their properties, but, nevertheless, does materially reduce the amount of dust that is raised during the bed-making and the ward-cleaning periods. A parallel reduction in the bacterial count of the air is observed following this procedure.

None of these methods are effective in eliminating the direct spread of infection from droplets sprayed by individuals with acute respiratory infections during coughing and sneezing. Such droplets contain highly virulent agents in high concentration. The principles involved in the conception of "isolation" and "barrier nursing" are still important to bear in mind and to practice if a reduction in the spread of droplet or contact infection is to be attained.

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ANDREAS VESALIUS

Four hundred years ago this month—June, 1543—a simple yet singular event occurred that has served as a landmark both in the procedure and in the conveyance of scientific thought. This event was the publication of the epoch-making book by Andreas Vesalius entitled *De Humani Corporis Fabrica*. It is most fitting to take cognizance of the quadricentennial of this publication. For the first time in the history of anatomy the fabric of the human body was represented as of and on this earth. Prior to the time of Vesalius, books were written on what might be called the idealized man. Vesalius, however, learned about the imperfections in the structure of the body from many firsthand observations and boldly set down these observations in his text. A distinguishing mark of this work is the fact that he alone carried out the dissections and demonstrations. This method was in striking contrast to earlier periods when dissections were performed either by a famulus, a demonstrator or an instructor. It is also important to note that Vesalius introduced the regular use of a mounted skeleton and other preparations to make clear his lectures. The Renaissance it may be recalled looked upon Man as a whole and upon Nature as essentially friendly. This point of view was vividly expressed in the *Fabrica*.

Vesalius was born in Brussels in 1514, five years before the death of Leonardo da Vinci. After pursuing studies at Louvain, Leyden and Paris, he received the coveted appointment as professor of surgery and anatomy at the great Italian university at Padua, the *mater gloriosa studiorum*. This university in particular fostered freedom of thought and leaned quite sympathetically toward those artists whose work began to influence the new scientific outlook.

It should be remembered that Vesalius was an artist as well as a naturalist and a humanist. And so it came about that he encouraged his friend, Stephen van Calcar, a pupil of the celebrated Titian, to make the superb illustrations that accompany the text of the *Fabrica*. This classic book will always remain the result of the indissoluble union of the scientist and the artist. It was through the efforts of Vesalius and van Calcar that the concepts of Galen, which had hitherto constituted a stable center for formalized and conventionalized medical thought, were almost completely broken down. A new method and spirit arose, which was calculated to lift all science to higher levels. We today may well remember Andreas Vesalius by the following words, which he had printed upon the fine figure of Death in the *Fabrica*:

> *Vivitur ingenio, caetera mortis sunt*
> [One lives for the spirit, all else belongs to death].

MEDICAL EPONYM

Weil-Felix Reaction

A paper entitled "Zur serologischen Diagnose des Fleckfiebers [Serologic Diagnosis of Typhus Fever]," by E. Weil (1880–1922) and A. Felix (b. 1887), appeared in *Wiener klinische Wochenschrift* (29:33–35, 1916). A portion of the translation follows:

> During the latter part of September, 1915, we had an opportunity to study bacteriologically, serologically and, in part, clinically, a group of cases of typhus fever in the town of R., in East Galicia. . . . Because of the coincident prevalence of typhoid fever, we were in doubt concerning the diagnosis in the first of our cases. . . . Nevertheless we were struck by the fact that no typhoid bacilli could be recovered from any of the first nine cases observed. . . . On the other hand we cultivated a micro-organism from the urine of patient V. . . . that was not agglutinated by typhoid, paratyphoid A and B or dysentery antiserums, but which did show agglutination with the patient's own serum in a 1:200 dilution. . . . Thirty-three cases observed in R. had been diagnosed as typhus fever. . . . All thirty-three serums gave an agglutination reaction with the bacillus under cultivation. . . . The specific agglutinins appeared at an early stage of the illness. They had reached their maximum at the time of appearance of the exanthem, persisted at this level during the febrile period of approximately fourteen days and quickly disappeared after defervescence. . . .
>
> We do not feel justified in regarding this germ as the provocative agent of typhus fever. . . . Nevertheless we apparently have in this micro-organism a means of assistance in the diagnosis of typhus fever.

The organism is further described as a "short, delicate gram-negative rod, resembling proteus, and weakly motile."

R. W. B.

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